TELEPHONE ENGINEER

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VALUES OF TELEPHONE PROPERTY

Reports of sales of telephone properties in various parts of the country, together with the activities of financial houses that have resulted in offers being made for many other properties, has aroused a considerable amount of discussion among telephone men as to the relations between values and selling prices of telephone property. It is quite natural that the differences of opinion have been very wide, depending upon the viewpoint of the holder of the opinion.

The viewpoint of the telephone executive who is considering the purchase of additional properties was expressed by Frank A. Knapp, retiring president of the Ohio Independent Telephone Association at the recent convention at Columbus and some of his conclusions are worthy of comment. After stating that the present-day value of a telephone plant can be established by engineers and public service commissions, he calls attention to the fact that it does not necessarily follow that a purchaser can be found who will pay this amount for the property. Appraised value is only one of the considerations and there are other elements entering into its desirability and its worth. If the plant is in bad physical condition or is operating at impossibly low rates, with a horde of executive problems to be worked out, prospective investors weigh the big investment in time and ability equally with the amount of money that must be paid. Every investor expects a profit when he acquires new property, and the greater the effort to put the plant on a satisfactory operating and rate basis, the greater the reward that is expected.

Mr. Knapp speaks as a telephone executive contemplating operation of the acquired property and expecting a profit because of his ability to make over a weak property into a strong one. It is to be feared that this is not the consideration with many who are in the field with offers for properties. Some of the prices paid and some of the financing plans submitted bear marks of having been designed to provide a maximum profit from the securities to be sold.

It is not likely that the public, or public service commission, will take kindly to rate increases made necessary in order that some one may realize a profit out of sales of securities or the re-sale of the property. A weak company can not be made into a strong one by the simple expedient of increasing its outstanding capitalization, and a strong company on a conservative capitalization may become a weak company if its stocks and bonds are increased, unduly. If the process is carried too far, there are bound to be failures, and every failure will be a blow to the conservatively managed company that is in business for operating profits, rather than for the profits that come from buying and selling.

SELLING EXTENSION TELEPHONE SERVICE

Recently, a number of telephone companies have been engaged in campaigns to increase the number of extension telephones in use. Some of these campaigns have resulted in considerable increases in the revenue from extension service.

This class of service is one that can be furnished in almost every exchange, as the installation does not require cable or switchboard facilities, nor does it add an appreciable amount to the operator loads. The only additional investment required is the instrument itself and the necessary inside wiring.

Few exchanges have reached the saturation point in main line stations, and still fewer even have approached saturation in the matter of extension sets. The selling of extension service is a field to which the commercial departments of most telephone companies can turn their efforts with the fullest assurance that they cannot fail to make a creditable showing.

PIECEMEAL AND PATCHWORK RECONSTRUCTION

One way of reconstructing telephone lines is by complete replacement. A new line is built of entirely new materials and, after it is finished, the old line is removed, usable material being returned to stock and the remainder junked. Occasionally, such reconstruction is necessary or justifiable, but many lines have not reached the stage where such replacement is needed. In fact, there are many lines where the day of complete replacement may

be postponed indefinitely by piecemeal reconstruction.

Few lines have been built completely in one operation. More frequently they have reached their present condition through several stages of construction. First, the poles were placed, with such cross arms and wires as were needed. Later, other cross arms and wires were erected, as service was required. From time to time, pole replacements were made, due to various causes, so that the present line is, really, a combination of elements of various ages, ranging from those at the point of replacement to those which are practically new.

Replacement of such a line may mean loss of much material and labor that is good for several years of service. On the other hand, deferring replacement may mean liability to complete line failure, due to some of the weak spots. An overhauling of such a line at regular periods will remove the weak spots and allow realization of the entire useful life of all good material. Such piecemeal reconstruction should include the testing of all poles, to make sure they have sufficient strength to last to the next period of overhauling; the inspection of cross arms and wire, anchors and guys and the replacement of all defective material.

Too often, however, this plan of piecemeal reconstruction degenerates into what may be called patchwork reconstruction. A pole or cross arm never is replaced until it fails completely and, as long as wire will hold together sufficiently to permit splicing, it is allowed to remain in service. Economical operation requires that each element of plant, as far as possible, shall remain in service at the place where it originally was installed until the end of its useful life. This does not mean leaving it in service until it falls to pieces, however, because the end of life is reached when it reaches a condition that no longer assures service of reasonable continuity.

TELEPHONE COMPANIES AND ZONING ORDINANCES

In certain states, where enabling legislation has been passed, a large number of cities have passed zoning ordinances designating certain areas as business, residence and industrial areas and placing restrictions on the type of buildings that are permitted to be erected in these areas.

Ordinarily, such restrictions will not affect telephone companies, except in the matter of central office building locations and types. In the smaller cities, where the exchange will be served from a single central office, the restrictions seldom will apply, as the wire center of the telephone distribution plant usually will be found in the main business center. Where the city is large enough to require more than one central office, it may be found that the proper location is in a strictly residential district and there is a possibility that some difficulty may be experienced in securing the necessary permission to erect a building of the type required for telephone service.

When zoning ordinances are being prepared or amended, the checking of the proposed areas against the fundamental plan of the telephone plant may save much future difficulty, if the definitions of the restricted areas can be adjusted to provide proper designations of the areas in which future central offices are likely to be located.

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GIVE THE OPERATORS A WORD OF ENCOURAGEMENT

The completion of arrangements for a correspondence course in long distance operating by the Traffic Committee of the United States Independent Telephone Association will offer an opportunity for many ambitious operators to improve their work. It should be especially beneficial to the operators in smaller offices, employing relatively few operators, for such offices can not afford to organize schools and seldom, if ever, have traffic officials who are capable of giving a complete course of instruction.

The management of such companies should encourage the enrollment of as many operators as can be interested. This encouragement should not end with the enrollment, however, but should be continued during the period when the operator is working on the course. It not always is easy to get out lessons in addition to many other duties and a word of encouragement now and then will help many operators to a successful completion of the course, who might otherwise fall by the wayside before the work is done.

Vermont to Meet June 29-30 at Burlington

Enosburg Falls, Vt.—C. L. Ovitt, secretary of the Telephone Association of Vermont, has announced the date of the sixth annual convention of the organization as June 29 and 30. The meeting will be held at the Van Ness House, Burlington.

Maine Announces Four District Meets in June

Bethel, Me.—A. Van Den Kerckhoven, secretary of the Telephone Association of Maine, announces that the state districts meetings this year will be held at Norway, June 14; Skowhegan, June 15; Belfast, June 16, and Bangor, June 17.

Soldering, the Biggest Little Thing in Telephony

By RAY BLAIN

Soldering is one of the most important jobs in telephone work and if not properly performed causes endless trouble. Many men, recognized as good telephone men, are not proficient in the use of soldering coppers and the making of good soldered connections.

The size and condition of the soldering copper and the condition of the connection to be soldered are the controlling factors in the making of a good soldered connection. A small slender soldering copper, while ideal for soldering small connections in a switchboard where space is limited, should never be used on the larger connections on the main frame as the heat will be conducted away too rapidly to allow the proper work to be performed. Soldering coppers should be drawn out to a point while hot by laying on an anvil, vise or any other smooth hard surface and hammered. The point can then be smoothed up and shaped with a file. The approved shape of a ¾ pound (per pair) copper for soldering on switchboard jacks and other small connections is shown in figure 1, and one to three pounds (per pair) copper for main frame and other large work in figure 2.

It is impossible to turn out good work with a dirty or stubby copper. The copper should be tinned by filing the surface of the point until it becomes bright and clean, then heating until it changes color rapidly. It is then removed from the heater, the surface filed quickly and rosin core solder applied, repeating the operation until the surface is well tinned. For telephone work the point of the copper should never be tinned on all sides. Both flat sides may be tinned, but usually one is enough, since one makes it easier to hold solder on the point without dripping off. The copper should never be tinned by melting solder and rubbing the surface on a salammoniac crystal. This does a very good job of tinning but a small amount of the salammoniac likely to remain on the copper is transferred to the connection while soldering and causes corrosive trouble. Under no circumstance should an acid base soldering paste or acid flux solder be used. The use of these materials on telephone systems is contrary to good engineering practice and trouble invariably results from their use for soldering small insulated wire. There are some soldering pastes on the market that do not have acid bases, but before using on a telephone system tests should be made to be certain that no harm will result. Rosin core solder will be found the most convenient to use and it never causes corrosion.

The first requirement in making a soldered connection is to be positive that the terminal and wire are both clean and tinned. If the surface of the terminal appears unsatisfactory, tin it with the copper and solder before connecting the wire. If the tin on the wire has been scraped off it may be retinned in the same manner.

Special care must be taken in cleaning enamel wire. This wire has its advantages, but many object to its use due to the difficulty of removing the enamel and preparing it for soldering. Some claim that the enamel can be burned off when soldering but I do not believe this method to be as successful as when every particle of the enamel is removed, before attempting to solder. The usual method of scraping off the enamel with a sharp knife or pair of pliers, and incidentally all the tin with it, makes soldering difficult and a good joint almost impossible unless the wire is retinned. By means of a small piece of hacksaw blade about one inch long held between the thumb and first finger and run along the enamel wire, with a slight pressure (after removing cotton covering), the enamel can be cracked off very easily and the tin uninjured. After terminal and wire have been prepared for soldering make the connection by giving the wire one complete turn around the terminal. Now hold the heated copper to the connection for an instant to heat up the wire and terminal, then touch the connection with a piece of rosin core solder and rock the copper slightly to work the heated solder down into the joint to make a good contact between the two, and remove the iron quickly. It is always best not to use too much solder on a joint as a little properly applied is better than much run onto a connection cold. This type of joint can be readily detected by visual inspection as the solder is rough and if picked with a sharp instrument will usually be found loose. Always be sure that enough heat is applied to burn off all surplus rosin, otherwise trouble may be experienced from rosin joints which are practically insulated with rosin, and partially covered over with solder. When the wire or wires are passed through a hole in the terminal be sure that the hole is filled with solder. A dental mirror will be found very convenient for inspecting

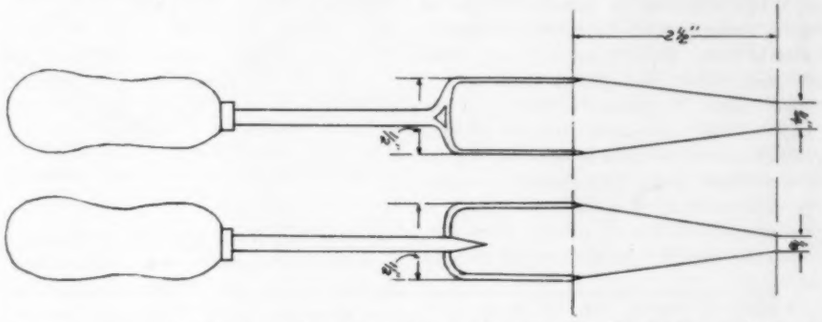


Fig. 1—Approved Shape of Soldering Coppers for Use on Switchboard Multiple Jacks and Other Small Jobs

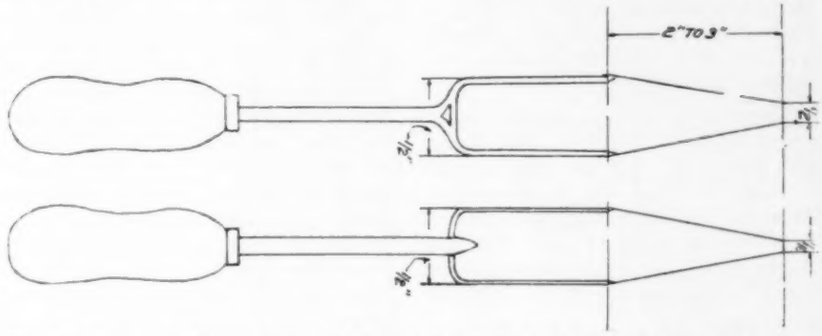


Fig. 2—Approved Shape of 1 to 3 Pound Per Pair Soldering Coppers for Use on Main Frame and Other Large Work

newly soldered joints as it will permit a magnified view of the connection from any angle with very little effort, and any defects will be readily detected.

Care must be exercised in handling heated soldering coppers to prevent burning of insulation on the wires being soldered or those adjacent, or heating the terminal lugs to such an extent as to soften the insulation that holds them in place.

In heating a soldering copper the flame should always be applied to the thickest part and never to the tinned point. Do not permit the copper to become red hot as this will soon destroy tinning on the point.

When soldering on horizontal side of main frame protect the terminals, immediately under those being soldered, from dripping solder by covering them with a small piece of fireproof muslin or an asbestos mat. A similar method of protection should be used when soldering on the multiple jacks. Protection of apparatus from dripping solder will always be found worth while as trouble from this source is usually intermittent and difficult to locate.

Fireproof muslin can be easily prepared in the following manner: Take ordinary unbleached muslin and cut into pieces of the size desired and dip into a sizing solution prepared by adding magnesium oxide to hot water until it presents a milky appearance. Allow muslin to dry and dip into sodium silicate (commonly called water glass). The sizing bath may be eliminated but muslin treated only with the sodium silicate will not have as much fire resisting properties as that given the full treatment. Muslin given the full treatment may not be absolutely fireproof, but will resist excessive heat and will not burst into flame but only smolder slowly if it burns at all.

A piece of muslin about eighteen inches square treated in the above manner and with a piece of No. 9 iron wire hemmed in along one edge will be found very useful to lay on apparatus to protect it from dripping solder. A small piece will also be found very convenient for wiping hot soldering iron to remove excessive solder or dirt.

The electric soldering coppers probably are not as desirable from every standpoint, as the gas heated type, but due to their convenience, are coming into very common use. One of the principal objections to the electric coppers is their fire hazard as the origin of several serious fires in telephone exchanges have been traced to their careless use. If a few simple rules are observed in their use, they are just as safe as any heating device. The cord on an electric copper should always be provided with a connecting plug so that it can be quickly disconnected from the socket upon the completion of each job. If the copper is installed permanently as on the main frame a switch may be provided and a red pilot lamp connected which lights when the copper is switched on. When the copper is not in use, even temporarily, it should be kept in a suitable holder provided for that purpose and not laid down on ladders or parts of the apparatus. These holders can be purchased at little cost or can be easily constructed as shown in figure three, by tacking an

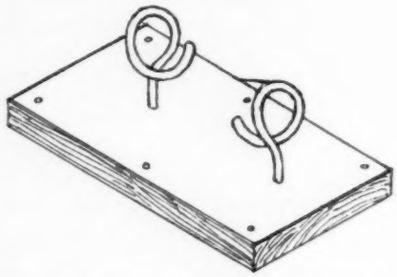


Fig. 3—Holder for Electric Soldering Copper

asbestos mat of the type used in mounting sub-station protectors on a piece of hardwood a trifle larger than the mat and screwing two bridle rings, of a suitable size, through the mat into the wood, spaced to hold the heating element of the copper. These holders should be mounted in convenient locations on the main frame and made portable for use about the switchboard. The copper should never be hung up by its cord while heating, as the heat is conducted from the point and may damage the handle. When possible the point should be pointed slightly upward while heating. The points of electric coppers may be shaped and tinned in the same manner as a gas heated copper, but if the point is drawn out by hammering it is best to remove it from the holder to avoid possible injury to the heating element. Various types of electric coppers are manufactured for different classes of work and special points can be easily made which will fill any requirement. A small copper with a corresponding small heating element should be procured for switchboard work and a larger one for main frame and other heavy duty.

A large electric copper should never be used in switchboard multiples because the size of the heating element and the large amount of heat that it radiates makes it almost impossible to avoid damage to the cotton insulation of the wires.

One of the very common errors in the use of small electric coppers, especially on new work, where many connections are prepared for soldering at one time, it will be found after soldering about ten connections that the copper has lost heat until it does not work properly. To avoid this, if a larger copper cannot be used, about ten connections should be prepared at one time for soldering.

Tests should be made at frequent intervals to determine whether the heating coil is crossed or grounded on the case of the copper, and if so, its use should be discontinued until repaired, otherwise a workman may receive a serious shock while working around grounded apparatus.

The following are three simple rules which, if observed, will insure good soldered connections at all times.

1. Clean, tinned and well shaped soldering coppers.
2. Clean, tinned wire and terminals.
3. Hold copper to connection long enough to insure heating so that solder will flux.

Hungary to Be Joined to International System

Budapest—With the view of linking Hungary with the international telephonic system, the Hungarian Post Office has concluded negotiations with the Austrian postal authorities. It has been decided to lay a new cable between Budapest and Vienna, which will be completed towards the middle of 1927. At the same time, cables between Vienna and Passau and Passau and Nuremberg are to be laid, so that the laying of the Budapest-Vienna cable means connection with the French, Belgian, Dutch, and Scandinavian systems. Among other neighboring states with which negotiations are in progress is Czecho-Slovakia, and negotiations will shortly be initiated with Jugo-Slavia, says Reuter's Trade Service.

India Sees Big Telephone Development

Calcutta, India—Remarkable strides in long-distance telephony have been accomplished in India during the past year, says the London Telegraph, and the line between Delphi and Calcutta will be opened on April 1. With the completion of the connection between Calcutta and the new capital the posts and telegraphs department will have carried out practically the entire project which was taken in hand three years ago. There only remains the 1,250-mile line between Calcutta and Bombay, on which work is proceeding. The cost has been enormous, and even optimistic experts now doubt the financial results.

Long Beach Educates Patrons in Automatic Principles

Long Beach, Cal.—"What you do when you dial" is the title of a pamphlet being circulated among the subscribers of the Associated Telephone Co. of Long Beach and San Bernardino. The principle of automatic telephone operation is quite clearly explained by this circular, which employs an analogy of bookshelves to bring out the selective character of automatic functioning.

Fundamental Mathematical Operations*

By F. J. DOMMERQUE
Fellow A. I. E. E.

9. Positive and Negative Numbers

In his schooldays the reader learned how to add, subtract, multiply and divide figures. Such knowledge may be quite sufficient for the baker's, butcher's and candlestick maker's primitive bookkeeping, physical laws having no direct concern with their trade. In the telephone man's daily work processes are involved which to a more or less extent are regulated by the laws of physics, even if he is not aware of it. If he is imbued with a desire to learn something about these laws, he must know a little more than what is given to him upon the grammar school benches; to impart this to him, the fundamental operations mentioned above will be repeated but in a somewhat different presentation more useful for the explanation of the subjects to follow. There will be added a few operations with which he probably is not familiar. Here again it will be difficult to fix a limit how far to go without exceeding the reader's capacity of assimilation. It seems safe, however, to present the fundamental conceptions of the operations mostly used and supplement them after by additional information, whenever at some future discussion the explanation of a physical law or process demands it. This chapter on operations may seem rather dry reading, but it is a matter of necessity.

In Fig. 8 the numbers from 0 to 9 are marked off on a horizontal line, starting from the origin 0; the numbers to the right are marked with a plus sign to show that they are positive, and the numbers to the left are marked with a minus sign to show that they are negative. This array of numbers indicates that they are arranged on a "decimal" basis, that is, that there are ten symbols, namely 0 to 9, which can be combined to form numbers of two, three, four and more places, 0 to 9 being single-place numbers, 10 to 99 being two-place numbers, 100 to 199 being three-place numbers, and so on; the numbers 0 to 9 only are shown in Fig. 8.

Mathematicians call the array of numbers shown in Fig. 8 the "axis of real numbers." In this array direction has been brought into play. In the ordinarily course of figuring the direction idea is not associated with negative numbers, but in physics this becomes necessary.

Considering a distance measured along the axis from 0 to +1; this distance is called a "unit." Taking direction only into consideration we call the distances measured from 0 to the right positive and measured from 0 to the left negative, but taking magnitude also into consideration we call the distances measured from left to right "positive strokes" and measured from right to left "negative strokes." Thus in Fig. 8 the distance from 0 to +1 represents the "unit stroke." The designation "stroke" is an unusual term and it is used here, as a term for such a directed quantity. The name, however, is of no importance as the stroke serves only as a stepping-stone to further explanations.

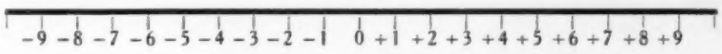


Fig. 8—Axis of Real Numbers

Strokes are not restricted to the axis of real numbers, they are restricted in location only to the plane of the paper, they can start from any point in the plane. A stroke is characterized by the position of its starting point, by its direction and by its length. In physical problems it has become customary to give to such directed lines as strokes the name "vector," although in pure mathematics a vector is a directed quantity in "space" and is applied to physical phenomena as forces, velocities, acceleration and many others. But space analysis does not concern us here at all; we work in the plane, and whenever we have to deal with forces, velocities, etc., we will be able to get along without such complications. Taking in Fig. 8 the unit stroke +1, inspection of the figure will show that this positive stroke is transformed into a negative stroke of the same magnitude by turning it around its fixed starting point, in this case the origin 0, until its end point reaches the opposite location; with other words until the stroke has made a "half-turn" around its starting point. What holds good for the unit stroke holds also good for any stroke.

Characterizing the positive stroke by two general letters, say "a" for its starting point and "b" for its end point, there would be many ways to characterize the negative stroke of the same magnitude by; one would be by simply placing a minus sign before it, thus: —a b; +a b or a b alone being the positive stroke; the reversing of direction could be indicated also by reversing the position of starting and end point, writing the negative stroke as b a; but the expression —a b indicates better the half-turn, that is, the "operation" which has been performed. In the latter case the sign — is the "operator," which operated on the stroke a b; thus the operator "—" turns a stroke through a half-turn.

Giving the stroke another half-turn would bring it back to its original position, which may briefly be stated as $- \times - = +$. The statement $- \times +$ would indicate a reversal of direction, also the statement $+ \times -$. The statement $+ \times +$ would mean the direction remains unaltered.

All that has been said of strokes applies also to numbers. Therefore, using again general designations we have $- \times + a = - a$; $- \times - a = + a$; $+ \times - a = - a$. These statements are more clearly written by the use of "parentheses," thus: $-(+a) = -a$; $-(-a) = a$; $+(-a) = -a$. "Parentheses ( )" and "brackets [ ]" are symbols to indicate that the expressions enclosed by them are to be considered as an entity, and are to be treated as parts of a single number expression. This will become clearer when the following laws are observed:

10. Laws of Addition and Multiplication

The *Commutative Law* states that numbers or strokes are added without restriction to the order in which they are added; hence we may write generally $m + n + o = m + o + n = o + n + m$. By the definition of the operator "—" we have turned subtraction into an inversed addition; hence all theorems which are evolved for addition may be applied for subtraction; consequently we may write also $m - n - o = m - o - n = -o - n + m$. The commutative law of multiplication would be that the factors can be arranged in whatever order of multiplication. Thus $m \times n \times o = m \times o \times n = o \times n \times m$. The *associative law* states that the numbers or strokes to be added can be

*Third article on "Telephone Mathematics and Physics."

grouped promiscuously. The general form for this rule may be written as

$$m+(n+o)=(m+n)+o.$$

We also write

$$m+(n-o)=m+n-o$$
$$m-(n+o)=m-n-o$$
$$m-(n-o)=m-n+o$$

which gives the following rule: If a plus sign precedes a parenthesis, the signs inside the parenthesis remain the same when the parenthesis is removed. If a minus sign precedes the parenthesis, the signs inside the parenthesis must be reversed when the parenthesis is removed. On the other hand, if it is desired to enclose terms within a parenthesis, the signs remain the same when a plus sign precedes the parenthesis, but if the sign preceding the parenthesis is a minus sign, the signs inside the parenthesis must be changed, as is shown by the example $m+n-o=m+(n-o)=m-(-n+o)$.

The associative law of multiplication would be: Factors can be grouped in whatever order of multiplication. Thus: $m\times n\times o=(m\times n)o=m(n\times o)$.

The *distributive law* of multiplication. If a sum or a difference of several numbers is to be multiplied by another number, each of the numbers in the parenthesis is then multiplied by the number outside the parenthesis and the results connected by the proper signs. Thus: $p(m+n-o)=pm+pn-po$.

Division is the inverse operation of multiplication, which can easily be shown on a numerical example. Given the dividend 20 and the divisor 5, then the quotient $\frac{20}{5}=4$ is obtained. If on the other hand 4 is multiplied by 5 the product 20 results. Expressed in general terms: If

$a\times b=c$, then $\frac{c}{a}=b$ or also $\frac{c}{b}=a$,

whence the rule: The product c is obtained by multiplying the multiplicand a by the multiplier b, or by multiplying the multiplicand b by the multiplier a, according to which factor is taken as multiplicand and which factor as multiplier. Correspondingly, the quotient b is obtained by dividing the dividend c by the divisor a, or the quotient a is obtained by dividing the dividend c by the divisor b, according to which factor of the product ab is taken as divisor.

The following rule is obtained for the sign relation:

For multiplication	For division.
$+\times+=+$	$+\div+=+$
$-\times-=+$	$-\div-=+$
$+\times-=-$	$+\div-=-$
$-\times+=-$	$-\div+=-$

11. Simple Algebraic Rules

With the information contained in the two preceding paragraphs the *elementary* and *fundamental expressions* of *algebra* in their most general form can now be presented and explained. These expressions are of great assistance in interpreting formulae as well as in solving problems. The reader is advised to study them carefully, if he is not already familiar with them, and to figure a number of examples by himself. It would be an impossibility to give every possible combination of operations that can be made, but who has mastered the fundamental combinations will find no difficulty in interpreting intelligently the more complicated ones.

$ac+bc=(a+b)c$ .....formula (1a)

$ac-bc=(a-b)c$ .....formula (1b)

Rule: To add or subtract two or more terms having a common factor multiply the sum or difference of the terms by the common factor.

$\frac{a}{c}+\frac{b}{c}=\frac{a+b}{c}$.....formula (2a)

$\frac{a}{c}-\frac{b}{c}=\frac{a-b}{c}$.....formula (2b)

Rule: To add or subtract two or more terms having a common divisor divide the sum or difference by the common divisor.

$\frac{ab}{c}=\frac{a}{c}b=\frac{b}{c}a$ .....(3)

Rule: To divide a product of two terms by a third term, either of the factors can be divided first by the third term, and then the quotient so obtained multiplied by the other factor.

$$\frac{\left(\frac{a}{b}\right)}{c}=\frac{a}{bc}=\frac{\left(\frac{a}{c}\right)}{b} \quad \text{.....(4)}$$

Rule: To divide a quotient of two terms by a third term, divide the dividend by the product of divisor and third term or divide the dividend first by the third term and then by the divisor.

Note: "In a formula containing one or more terms in parenthesis, the operations on the terms in the parenthesis are performed first, so as to remove the parenthesis, and then the terms are combined."

$\frac{a}{b}\times\frac{c}{d}=\frac{ac}{bd}$ .....(5)

Rule: To multiply two quotients by each other, divide the product of their dividends by the product of their divisors.

$$\frac{\left(\frac{a}{b}\right)}{\left(\frac{c}{d}\right)}=\frac{a}{b}\times\frac{d}{c}=\frac{ad}{bc} \quad \text{.....(6)}$$

Rule: To divide one quotient by another quotient, multiply the first quotient by the second quotient with dividend and divisor interchanged, or divide the product formed of dividend of first quotient and divisor of second quotient by the product formed of divisor of first quotient and dividend of second quotient.

$(a+b)(c+d)=ac+bc+ad+bd$ .....(7a)

$(a-b)(c-d)=ac-bc-ad+bd$.(7b)

$(a+b)(c-d)=ac+bc-ad-bd$.(7c)

Rule: To multiply two sums or two differences by each other or a sum by a difference, multiply the terms of one sum or difference by the terms of the other sum or difference individually, arranging the signs in accordance with the rule of sign relation for multiplication.

If the sums or differences to be multiplied are alike, the following formulae are obtained:

$(a+b)(a+b)=(a+b)^2=a^2+2ab+b^2$ .....(8a)

$(a-b)(a-b)=(a-b)^2=a^2-2ab+b^2$ .....(8b)

$(a+b)(a-b)=a^2-b^2$ .....(8c)

$(a+b)^3=a^3+3a^2b+3ab^2+b^3$ ....(8d)

$(a-b)^3=a^3-3a^2b+3ab^2-b^3$ ....(8e)

$(a+b+c)^2=a^2+b^2+c^2+2ab+2ac+2bc$ .....(8f)

The reader is advised to work out examples for the formulae so far developed, taking for instance the value 5 for a, the value 0.35 for b, the value 20 for c and the value 4 for d, and see whether his solutions give him the answer 107 for formula (1a); 93 for (1b); 0.2675 for (2a); 0.2325 for (2b); 0.0875 for (3); 0.714285714.....for (4); 71.428-5714.....for (5); 2.8571428.....for (6); 128.4 for (7a); 74.4 for (7b); 85.6 for (7c); 28.6225 for (8a); 21.6225 for (8b); 24.8775 for (8c); 153.130375 for (8d); 100.544625 for (8e); 642.6225 for (8f). As general and necessary information for the comprehension and solution of formulae a few special usages will be discussed; but first a few definitions of expressions will be given.

A "term" is an expression all by itself; that is, not connected with any other expression by a plus or minus sign. Such an expression is also called a *"monomial."* An expression having two terms is called a *"binomial,"* and an expression having three terms a *"trinomial."* In general, an expression having more than one term is a *"polynomial."* In solving mathematical problems and in arranging formulae it is customary to arrange a polynomial in descending powers of one of its letters if that letter contains the highest power; for example the expression $5xy^3-4x^2y^2+3y^4+x^4-2x^3y$ can be arranged in descending powers of x, when it will read as follows: $x^4-2x^3y-4x^2y^2+5xy^3+3y^4$; or it can be arranged in descending powers of y, when it will read as follows: $3y^4+5xy^3-4x^2y^2-2x^3y+x^4$.

A "common factor" of two or more terms is a factor of each of them. In formula (1a) and (1b) "c" is a common factor. Sometimes an expression can be simplified by writing the product of the common factors outside of a parenthesis

and the remaining factors of each term inside the parenthesis; for example, if the expression $5abx^2+10a^2b^2x^3+15ab^3x^4$ is given, the common factor $5abx^2$ can be written outside of the parenthesis, thus: $5abx^2(1+2abx+3b^2x^2)$. To understand the reason why this can be done, we must learn something about powers which will be done immediately in the following paragraph.

As to the multiplicity of operations with algebraic expressions it may be said that the reader will never become as efficient in them as a scholar is, who for months and years has been practicing on the subject, nor is this necessary, as only a few telephone men are called upon to do constructive mathematical work and these few are mostly college-educated engineers; the information given here will be sufficient for reference and for the intepretation of the mathematical formulae commonly employed.

12. Involution and Evolution

Involution and evolution may be something entirely new to the reader; this should urge him all the more to assimilate the brief account of these two important operations which is given here. If found necessary, the subject will be taken at some future occasion.

By involution the process is designated whereby the "power" of a number is found, while evolution designates the process of finding the "root" of a number. Evolution is the inverse operation of involution, as will be illustrated presently.

We already have learned that $r \times r = r^2$, where the *2* placed above and to the right of r is called the *exponent;* we add now the designation *base* for r and *power* for the result; that is, for r^2. The value taken for r in the original example was *3*; hence we have $3 \times 3 = 3^2 = 9$. The statement $3 \times 3 = 9$ tells us that the base *3* must be used twice as factor to produce the power 3^2 or 9. Now suppose the base *3* to be unknown, but the power 9 and the exponent *2* were given or known, and that we desired to find the value of the base; then we would write the problem thus: $\sqrt[2]{9} = 3$, which is read as "square root of nine equals three." The symbol $\sqrt{\ }$ is used for the process of "extracting" a root and is termed the "radical sign." It was first introduced in Germany and appears to have been meant to indicate an r, which is the first letter of the latin "radix," the word for root. The *2* over the radical sign is called the *index* of the radical sign and the 9 under the radical sign the *radicand.* It should be mentioned that the radical sign consists of two parts, namely the symbol $\sqrt{\ }$ proper and a vinculum $\overline{\ \ \ }$, the latter acting as a parenthesis to indicate the entire expression which the radical sign has to cover, as for instance in the formula $\sqrt{(R+jwL)(G+jwC)}$, which designates the value of the propagation constant in a telephone line; this formula is of great importance in modern telephony.

Roots with the index *3* are called "cube roots." Generally speaking, $\sqrt[n]{a}$ indicates the nth root of a, or also that $\sqrt[n]{a}$ is a radical of the nth order. Thus the process $a \times a \times a \times \overbrace{\ldots\ldots}^{\text{n times}} \times a = a^n$ is involution, and the process $\sqrt[n]{\overbrace{a \times a \times a \times \ldots\ldots \times a}^{\text{(n times)}}} = a$ is evolution, which clearly shows that evolution is the inverse of involution.

It may be stated right here that the square root and the cube root are about all the roots that occur in ordinary practice. The index *2* is usually omitted, thus $\sqrt{a}$ always means the square root of a. If involution and evolution are considered in their relation as inverse operations it becomes apparent that $(\sqrt[n]{a})^n = a$, for example $(\sqrt{3})^2 = 3$; and also $\sqrt[n]{a^n} = a$, for example $\sqrt{3^2} = 3$.

After these preliminaries we can continue the discussion of the fundamental algebraic formulae, as follows:

$a^m \times a^n = a^{m+n}$ ..... formula (9a)

The proof of this is very simple:

a^m is $a \times a \times a \times \overbrace{\ldots\ldots}^{\text{(m times)}} \times a$

a^n is $a \times a \times a \times \overbrace{\ldots\ldots}^{\text{(n times)}} \times a$

$a^m \times a^n$ is $a \times a \times a \times a \times \overbrace{\ldots\ldots}^{\text{(m+n) times}} \times a$ or a^{m+n}

$$\frac{a^m}{a^n} = a^{m-n} = \frac{1}{a^{-m+n}} = \frac{1}{a^{n-m}} \ldots\ldots \quad (9b)$$

Proof:

$a^m = a \times a \times a \times \overbrace{\ldots\ldots}^{\text{m times}}$

$a^n = a \times a \times a \times \overbrace{\ldots\ldots}^{\text{n times}}$

$$\frac{a^m}{a^n} = \frac{a \times a \times a \times \overbrace{\ldots\ldots}^{\text{m times}}}{a \times a \times a \times \underbrace{\ldots\ldots}_{\text{n times}}}$$

It is assumed that $m > n$, hence n times a in the divisor cancels against as many a in the dividend, leaving $(m-n)$ times a, whence $\frac{a^m}{a^n} = a \times a \times a \times \overbrace{\ldots\ldots}^{\text{(m-n) times}}$ or a^{m-n}.

As $a^m \times a^n = a^{m+n}$, it follows $a^m \times a^o = a^{m+o} = a^m$; dividing both sides of this equation by a^m we obtain $a^o = 1$. Furthermore, $a^m \times a^{-m} = a^{m-m} = a^o = 1$. Dividing again both sides of the equation by a^m we obtain $a^{-m} = \frac{1}{a^m}$; consequently we can write for a^{m-n} also $\frac{1}{a^{-(m-n)}}$ or $\frac{1}{a^{-m+n}}$ or $\frac{1}{a^{n-m}}$.

As an application of the above deductions, attention may be called to the method of writing multiples of 10, which is used to a very great extent in physics. Ten can be written as 10^1; 100 or 10×10 as 10^2; 1000 or $10 \times 10 \times 10$ as 10^3; 10,000 or $10 \times 10 \times 10 \times 10$ as 10^4 and so on. Correspondingly $\frac{1}{10} = 10^{-1}$; $\frac{1}{100} = 10^{-2}$; $\frac{1}{1000} = 10^{-3}$; $\frac{1}{10{,}000} = 10^{-4}$ and so on.

$(a^m)^n = a^{mn}$ ..... (10)

Proof:

$(a^m)^n = a^m \times a^m \times a^m \times \overbrace{\ldots\ldots}^{\text{n times}}$

$= a^{m+m+m+\ldots\ldots}$ (n times)

hence $(a^m)^n = a^{mn}$.

$(ab)^n = a^n b^n$ ..... (11a)

Proof:

$(ab)^n = (ab) \times (ab) \times (ab) \times \overbrace{\ldots\ldots}^{\text{n times}}$

$= (a \times a \times a \times \overbrace{\ldots\ldots}^{\text{n times}}) \; (b \times b \times b \times \overbrace{\ldots\ldots}^{\text{n times}})$

$= a^n b^n$

$$\left(\frac{a}{b}\right) = \frac{a^n}{b^n} \ldots\ldots \quad (11b)$$

Proof:

$$\left(\frac{a}{b}\right)^n = \left(\frac{a}{b}\right) \times \left(\frac{a}{b}\right) \times \left(\frac{a}{b}\right) \times \overbrace{\ldots\ldots}^{\text{n times}}$$

$$= \frac{a \times a \times a \times \overbrace{\ldots\ldots}^{\text{n times}}}{b \times b \times b \times b \times \underbrace{\ldots\ldots}_{\text{n times}}}$$

$$= \frac{a^n}{b^n}$$

Taking up again the expression $5abx^2+10a^2b^2x^3+15ab^3x^4$, the common factor $5abx^2$ is found as follows: Arranging the expression in descending powers of x we obtain $15ab^3x^4+10a^2b^2x^3+5abx^2$. $15ab^3x^4$ can be resolved into $3 \times 5ab^{1+2}x^{2+2} = 3 \times 5ab^3b^2x^2x^2 = 5abx^2(3b^2x^2)$; $10a^2b^2x^3$ can be resolved into $2 \times 5aabbxx^2 = 5abx^2(2abx)$; $5abx^2$ can be written as $1 \times (5abx^2)$; hence the given expression becomes $5abx^2\ (3b^2x^2+2abx+1)$, the same as before only the one factor was written with the summands in different order, which will not change the value.

In the expression just developed the common factor was recognized by inspection. If the case is not as simple as the above example, the same end is obtained by performing a division: We will illustrate this on an example, namely $\frac{a^3+b^3}{a+b}$. The division is performed similar to the ordinary division with figures.

$a^3+b^3 : a+b+a^2-ab+b^2$

a^3+a^2b

$-a^2b+b^3$

$-a^2b-ab^2$

ab^2+b^3

ab^2+b^3

no remainder

Divide first a^5 by a, obtaining a^2. Then multiply $a+b$ by a^2, obtaining a^3+a^2b; subtract this from a^5+b^3, leaving the remainder—a^2b+b^3; divide this again by a, obtaining $-ab$; multiply $a+b$ by $-ab$ obtaining $-a^2b-ab^2$; subtract this from $-a^2b+b^3$ giving the remainder ab^2+b^3 as second remainder. Divide again by a obtaining b^2; multiply $a+b$ by b^2 and obtain ab^2+b^3; subtracting this leaves no remainder.

Anyone desirous of becoming more versed in "factoring," as the process of resolving products into its constituent factors is called, must have recourse to textbooks on algebra, but the brief analysis given here will be sufficient for the interpretation of the formulae ordinarily met with. Especially complicated expressions will be analyzed, whenever they occur.

In correspondence with the fundamental formulae 9 to 11 of involution stands the following set of formulae of evolution:

$$\sqrt[n]{a}\,\sqrt[n]{b}=\sqrt[n]{ab} \quad \text{.....formula (12a)}$$

$$\frac{\sqrt[n]{a}}{\sqrt[n]{b}}=\sqrt[n]{\frac{a}{b}} \quad \text{.....(12b)}$$

$$(\sqrt[n]{a})^m=\sqrt[n]{a^m} \quad \text{.....(13)}$$

$$\sqrt[m]{\sqrt[n]{a}}=\sqrt[mn]{a} \quad \text{.....(14)}$$

$$\sqrt[pn]{a^p}=\sqrt[n]{a^p} \quad \text{.....(15)}$$

$$\sqrt[n]{a^m}=a^{m/n} \quad \text{.....(16)}$$

The reader can find proofs for the above formulae by solving examples with figures, as for instance:

$\sqrt{4}\times\sqrt{9}=\sqrt{36}=6$

$\sqrt{3^4}=\sqrt{3\times3\times3\times3}=\sqrt{81}=9$;

$3^{4/2}$ also $=9$.

Often the formulae are used for simplification of expressions as in the example $\sqrt{12}+\sqrt{27}=\sqrt{4\times3}+\sqrt{9\times3}=2\sqrt{3}+3\sqrt{3}=(2+3)\sqrt{3}=5\sqrt{3}$.

Reverting to the formula for the average length of subscriber's lines, namely, $L'=\frac{L}{\sqrt{o}}$, where L designates the average length with one office and L′ the average length with o offices, an example may now be calculated. In the Chicago case the average length of subscriber's lines for one office was found as 20,000 feet. Assuming it is desired to find the average length with 12 offices in the system, then the formula would read $L'=\frac{20000}{\sqrt{12}}$. To solve this formula, the $\sqrt{12}$ would have to be determined. We know that $\sqrt{12}=\sqrt{4\times3}=\sqrt{4}\times\sqrt{3}=2\sqrt{3}$. Therefore the square root of 3 must be obtained, which is done as follows:

As $\sqrt{1}=1$ and $\sqrt{4}=2$, the square root of 3 must have as first figure 1, to be followed by decimal places. To extract the square root the figure 3 is therefore extended by a series of zeros, which do not mean anything, but serve for convenience, thus: 3.0000000..... We then divide this new expression into groups of two, so-called "periods," thus: 3.00|00|00|00|..... (If we had to find the root of a number with figures in the decimal places we would do the same, as for instance $\sqrt{3.67|35|98}$..... We always divide the radicand into groups of two, to the left as well as to the right, beginning at the decimal point, as for instance $\sqrt{4|85|76\text{-}67|35|98}$.)

$$\begin{array}{r} 346 \\ 34 \\ 2 \\ \hline \sqrt{3.00|00|00}\ldots\ldots = 1.732\ldots\ldots \\ 1 \\ \hline 200 \\ 189 \\ \hline 1100 \\ 1029 \\ \hline 7100 \\ 6924 \\ \hline 176 \end{array}$$

Returning again to $\sqrt{3}$, we now proceed as follows:

Square 1 and subtract from 3; append to the remainder 2 the period 00; double the root already found; that is, double 1, obtaining 2 (as indicated above); this 2 is to be used as a trial divisor by dividing the two first digits of the remainder; that is, 20 by 2, leaving the last 0 for the last digit of the trial divisor. This last digit will be 7, as 8 would render the divisor too great. Hence the complete trial divisor is 27. Multiply 27 by 7, obtaining 189; subtract 189 from 200; append to the remainder 11 the next period 00; double again the root already found, for the trial divisor, making it 34. Divide 110 by 34, obtaining 3; multiply 343 by 3, obtaining 1029. Subtract from 1100, leaving 71 as remainder. Annex the third period 00; double 173, obtaining 346. Divide 710 by 346, obtaining 2. Multiply 3462 by 2, obtaining 6924. Subtracting leaves 176 as remainder. There is no necessity of finding any more decimal places, 1.732 is near enough for our purpose, in fact the value 2×1.73, or 3.46, will be sufficiently close for $\sqrt{12}$. Hence $L'=\frac{20,000}{3.46}$ = approximately 5783 feet.

It may be said that the long method of extracting roots is hardly ever used. Those that have to do that kind of calculating use tables of roots which are found in handbooks or make use of logarithms of which we will speak some other time.

Independent Leaders Form $11,000,000 Financing Unit

Lincoln, Neb.—Continental Telephone Co., a holding, operating and financing organization with an authorized capitalization of $11,000,000, has been formed by some of the foremost factors in the Independent telephone industry of the central west.

Officers of the Continental company are:

President: Frank H. Woods, president of the Lincoln (Neb.) T. and T. Co.

Chairman of the Board: G. W. Robinson, president of the Tri-State Telephone Co., St. Paul, Minn.

Senior Vice-President: W. G. Bickelhaupt, president of the Dakota Central Telo. Co., Aberdeen, S. D.

Vice-Presidents: J. H. Agee, general manager of the Lincoln T. and T., and George K. Gann, general superintendent of the Tri-State T. and T.

Treasurer: C. B. Randall, general counsel of the Tri-State T. and T.

Secretary: Thomas C. Woods, vice-president of the Lincoln T. and T.

The above officers constitute the Continental directorate. Other officers are: W. L. Lemon, assistant auditor of the Lincoln T. and T., assistant treasurer, and A. C. Cragg, Tri-State T. and T., assistant secretary.

Formation of this company by successful Independents whose properties are valued at $50,000,000 is regarded by many as the most important development of recent years in the Independent branch of the industry. The Continental not only brings into the picture a ready market for Independent properties whose owners might be interested in selling, and an assurance that these properties would continue under the Independent banner as ably operated units sharing the advantages of expert centralized management, but it introduces to the scene a financing organization greatly needed by the Independents. This latter phase of the Continental's operations will protect, the Continental's factors believe, the entire Independent industry against promoters who are viewing the prospect of a quick cleanup and following that, an abrupt departure, at the expense of the Independent situation.

The Continental's plans involve no exchanges competing with the Bell under the management of the newly-formed organization. Banking and financing arrangements were completed prior to formal launching of the continental.

Theory and Operation of Ringing Systems Described

By P. KERR HIGGINS

Many different kinds of telephone service are offered to the public by the various telephone companies. These various services may be subdivided under the following classes: (1) Direct, or private line; (2) two- or four-party line; and, (3), multi-party line. The limiting number of stations on the latter is dependent upon what the subscribers will be satisfied with. This type of party line is known as the rural bridging system and may have anywhere from five to twenty-five or more stations. When ten or less stations are in use, it is common practice to use 1600-ohm ringers, while with more stations than ten it is found advantageous to use 2500 ohms. The calling of a desired party on such a line is done by means of code ringing whereby each subscriber is assigned a definite ringing code consisting of a combination of long and short rings. There are many different codes used for indicating the number and duration of rings and it seems as though each community prefers its own code.

Some use a dot and dash system after a number in which the number indicates the line and the dot indicates the short ring and the dash the long ring, while others use a numerical or letter code to indicate a certain number of long and short rings. The writer has investigated quite a number of these systems and found the following method the simplest, most convenient and easiest remembered by the operator, as well as having the advantage of giving each subscriber a separate number. This method consists of separating the two last digits of any number and using them for long and short rings; for example, the number 2622 would indicate line No. 26 two long and two short rings. The first two digits (in this case 26) indicates the line number, the third digit indicates the number of long rings and the fourth digit indicates the number of short rings. Several combinations can be made of long and short rings, the only number to be avoided being one long ring, as this is used by all the parties on the line when calling central. We might, therefore, use such combinations as 2601 (one short ring), 2611 (a long and a short), 2612 (a long and two short), 2602, 2603, 2604, 2605 (all indicating short rings) and 2620, 2630, 2640, 2650 (indicating long rings). Besides this, there may be combinations of long and short or short and long rings as may be desired. It is, however, considered good practice to keep down the number of long or short rings to five.

One of the objections of the multi-party line, such as described, is that when a certain subscriber on any line is desired, all the bells on that line will be rung with that party's combination of long and short rings. Only the particular number called is supposed to answer. However, in practice we all know that nearly every one who is at home on the line will take down their receiver to see what is going on, and this greatly interferes with the service rendered over such a line. The introduction of a condenser into the secondary circuit of each telephone has a tendency to reduce this interference.

In the case of the two-and four-party line, selective ringing is most frequently used. In this system only the bell of the desired subscriber will be rung and all other bells on the line will remain silent. There are two general types of selective ringing; one using different frequencies and one using positive and negative pulsating current.

In the last previous article we described the harmonic ringing equipment which seems to have interested quite a number of our readers, a number of whom have asked for some additional information regarding the harmonic ringer at the substation. It will be observed, from the previous article, that the operator at the central office had available four different kinds of alternating current which are obtained from four different vibrators on the ringing equipment. Any one of these four kinds of currents (having four different frequencies) may be sent out over any line, as desired by the operator.

In trying to understand the ringer at the substation or the current sent out from central, we must have a clear idea of the term "alternating current." This current, as its name implies, alternates in its direction when passing through a wire. An analogy of this is seen in the piston rod of a steam engine in motion, the piston rod alternating back and forth in its direction of travel. While all of these four currents are alternating in character, yet they differ from each other in frequency; that is to say, they alternate at different rates. For example, one of them may alternate approximately sixteen times, another thirty-three, another fifty and still another sixty-six times a second. In each of the four telephones on a harmonic party line is located a ringer or bell which will respond to only one of these four kinds of current.

The fundamental principle on which these ringers operate is that every pendulum of vibrating reed has a natural period of vibration and so may be made to swing or vibrate by the action of a succession of impulses occurring in the same frequency as that natural vibration period. An analogy of this may be found in an ordinary swing which may be made to vibrate to and fro by a gentle push of the hand applied at proper intervals. Now, if we have four swings, each provided with a different length of rope, the one having the shortest rope will swing fastest and the one with the longest rope slowest, so that we may have four swings vibrating to and fro in different lengths of time. The same thing is true as applied to the armature of the subscriber's ringer, as shown in Fig. 1. Another illustration may be given by considering four strips of steel fastened on a vise and so arranged as to

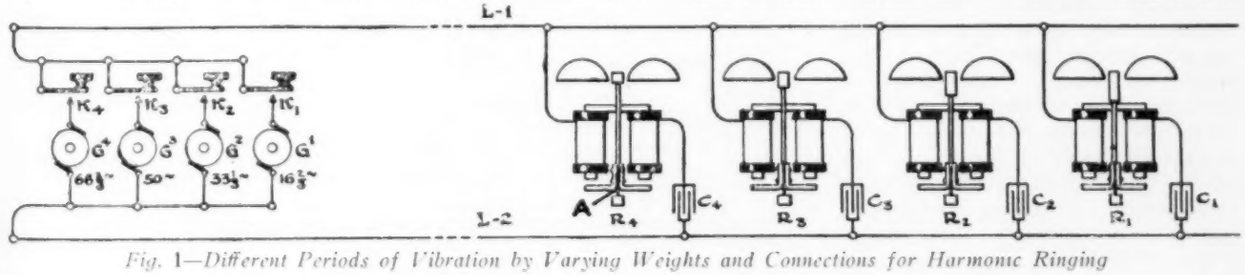


Fig. 1—Different Periods of Vibration by Varying Weights and Connections for Harmonic Ringing

strike bell gongs. If the length of the strips of steel were different, then the same thing would be true: that the shortest length would vibrate the fastest, and the longest length would vibrate the slowest. Now we can see from Fig. 1 how the harmonic ringers respond to the different frequencies sent out on the

Fig. 2—Harmonic Ringer

line. In this case, the length of the four reeds are the same, but it will be noted that the weight at the top is different in each case. In addition to this, the strength of the steel spring and at the bottom of the reed is also varied. We now add to this combination, as shown, electro magnets such as are used in ordinary ringers and we have the complete harmonic ringer as shown in Fig. 2. In selective ringing, only one bell is rung at a time and no code need be used. In the semi-selective system only a part of the bells are rung at any one time which reduces the number of code signals necessary.

The Biased Telephone Ringer

This type of ringer was mentioned briefly in the April, 1926, issue of TELEPHONE ENGINEER, Fig. 1, page 25. This ringer is nothing more than an ordinary polarized bell, with a spring arranged to draw the armature and clapper over to one side. The bell possesses the usual electro-magnet consisting of a yoke and two cores, each bearing a coil of wire. A permanent steel magnet furnishes magnetic flux, which, coming as it does from above, enters the armature at the center and divides, part going down through each core and coming together at the yoke, from which point it enters the south pole of the magnet and then travels upward to the north pole again.

Pulsating current is used to ring a bell of this type and may be generated by an ordinary alternating generator of any kind, provided all the half cycles in a given direction are suppressed. This is illustrated in Fig. 3, where the current is represented by the line A-B-C-D-E-F. The straight horizontal line is the zero line from which current strength is measured, upward and downward, while the vertical line indicates the current, beginning at positive and ending at negative, with zero in the center, at which point the horizontal line begins. Time is regarded as flowing from zero to the right as indicated by the arrow. Hence, at zero time, no current is flowing. After a short time has elapsed, the current is flowing in a positive direction, as indicated by the wave A. Later, this current falls back to zero, as at B, reverses and flows in an opposite direction, as indicated by the wave C. Now, in using the pulsating current, we imagine that the dotted portion of the curve is erased, and hence we have only left the pulsating current, which means that the current flows in a given direction for a short time, drops to zero and remains for a time, then flows again in the same direction as at first.

Although a biased bell will ring with straight alternating current, there is no selective action to be secured by it. On the contrary, if pulsating current is sent through the bell, it will move the armature against the force of the spring with every pulsation and, during the interval between pulsations, the spring will draw the armature back again. It is important that the wires connected to the ringer be connected up in the proper manner; that is, the positive to the positive and the negative to the negative. If this is not done and the pulsating current enters the bell with the wrong polarity connected, it simply will push the armature in the same direction as it is held by the spring and so the bell will not ring at all.

This system may be used for two-party lines without any ground connection. It also is used largely on common battery switchboards for four-party line service. This is accomplished by bridging two bells from each line wire to ground. However, this has a tendency to make the line noisy, because of induction and earth currents. There is, also, considerable leakage of batteries in common battery systems. It is to overcome these objections that the harmonic system has been so extensively used in recent years.

In Fig. 4, is shown, graphically, several varieties of ringing current, as it is very important in the study of central office ringing equipment to know these various types and recognize them when necessary. It will be noted that the zero point marks the inception and completion of every half wave or half cycle, as it is sometimes called, the complete reversal of the current being known as the full cycle, which in a two-pole generator means one complete revolution of the armature. Hence, if the armature is revolved at the rate of 960 times a min-

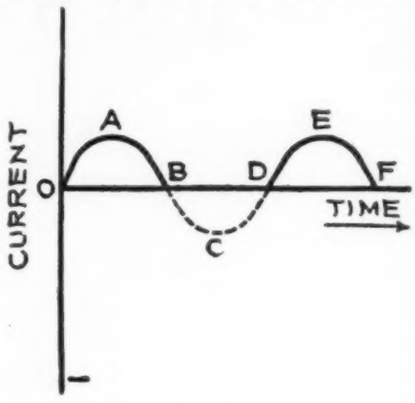


Fig. 3

ute, there will be 16 complete revolutions every second and such a current would be known as a 16-cycle current, this being the frequency generally used for a straight ringer.

The basic principle of the production of current, other than from a battery, is by a revolving armature carrying a coil of wire in a magnetic field. While it would be possible to construct a permanent magnet ringing machine of almost any size, there is no economy in doing so. The magnets are needed only to produce a magnetic field and this may be done equally well by the use of electro-magnets, resulting in a very substantial economy of size in machines of large output. Some machines are designed to furnish both alternating and pulsating currents and are so arranged that the same winding produces both. In such cases the alternating output usually is given a higher value as regards voltage than the pulsating current, the alternating current output being rated at 70 or 80 volts, while the pulsating current is rated at 60 or 65. It is to be noted that the current has the form known as the sine wave. The determination of the voltage of the sine wave is obtained by a mathematical calculation which involves the sum of the voltages of different stages of the wave formation and, also, a consideration of both halves of the wave from its beginning to its positive peak, thence back to zero, again rising to the negative polarity and back

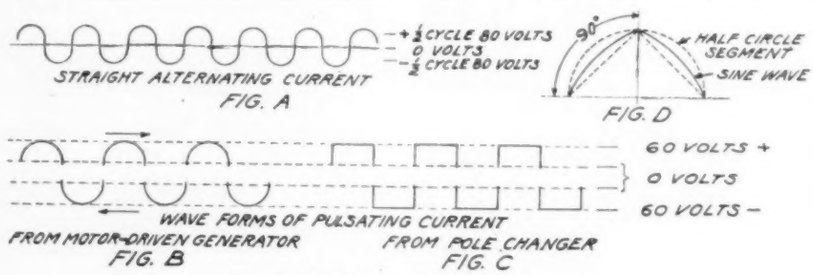


Fig. 4—Varieties of Ringing Current

to zero again. Such readings are made with an alternating current voltmeter. In Fig. 5, is shown a typical motor generator or dynamotor for use in small exchanges. In Fig. 6, is shown, graphically, the number of poles and cycles and their relation to each other in a two, four and eight-pole machine. In Fig. 7, this is illustrated in wave lengths.

Super-Imposed Ringing

Superimposed ringing current is an improved pulsating current made from a combination of direct current and alternating current. It was developed by the Western Electric Co. with a view to making a smoother wave and of getting the benefit of slip rings in place of commutator segments in producing the current. The method of production is very simple and makes possible the use of the regular alternating current machines. In order to explain this in detail reference is made to Fig. 8. In this figure, are shown the connections required in a superimposed ringing system. The letter A shows a regular alternating current generator, producing a regular alternating wave. B and C are two sets of batteries, each having a voltage of from 40 to 50 volts. Both storage and dry batteries have been used for producing the direct current. Either may be used in accordance with the amount of current required. In Fig. B of Fig. 8 is shown the wave produced by a regular alternating current generator, while Fig. C shows the current produced with the super-imposed arrangement. The dotted line indicates the part of the negative wave which has been eliminated by the battery B. Fig. D shows the negative current and here again the dotted line shows how the positive current has been eliminated by the battery C. With the superimposed ringing system, better margins may be had for the operation of biased bells. This is a direct result of a simpler and more uniform wave, due to the use of a regular alternating current generator which normally produces practically sine wave. Another advantage of the superimposed current is that when a condenser is placed in series with the ringer on the lines the path or direct current from the batteries is eliminated and, therefore, the alternating current is the only current effective on the bell. It is possible, therefore, to ring single party lines perfectly with any one of the four-party line buttons.

Reactance—Three Kinds Described

A correspondent asks for information regarding reactance. It is hoped the following may be helpful. There are three kinds of reaction set up in a circuit in which an alternating current is flowing—capacity reaction, inductance reaction and resistance reaction. Reaction is the power of resisting, or the tendency to force current in the circuit. Circuits and conductors of all kinds are capable of storing a certain amount of electrical energy. This property is termed capacity. The action of a conductor having this property of capacity on an alternating current is to absorb a certain portion of it, as the pressure increases and to give it back as this pressure decreases. In other words, when the pressure is building up, it has a tendency to raise the potential in the capacity of the line. When this has reached its maximum and the pressure is on its downward path, the line discharges the current, thus stored, but in the opposite direction to the pressure or E M F. Again, an electric current flowing through a conductor creates or sets up a field of force around the conductor and covering its entire length.

Fig. 6

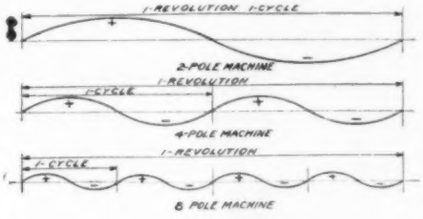


Fig. 7

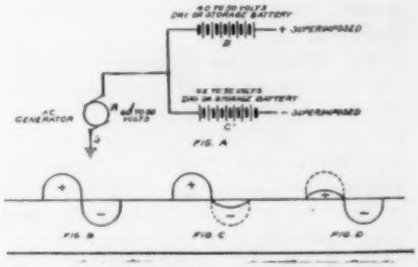


Fig. 8—Diagram Illustrating Superimposed Ringing

This field of force is composed of magnetic lines extending in closed curves around the conductor. These lines of force go in a direction at right angles to the flow of the current in the conductor. Now, if two wires are run parallel (side by side) forming a pair of telephone wires and the current is flowing in opposite directions in each, it then will be seen that the magnetic lines of force are opposing each other. If one line has current flowing on it and the other has none, then the one carrying the current will set up or create an induced current in the other wire producing cross talk or induction. Resistance reaction is the familiar reaction in which electrical pressure is used up in forcing the current through the resistance of the wire. It is similar to the reaction due to friction which requires force to overcome when one surface is sliding over another.

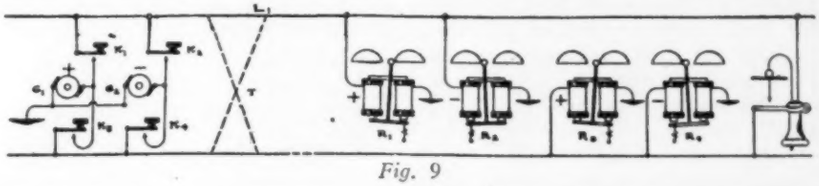


Fig. 9

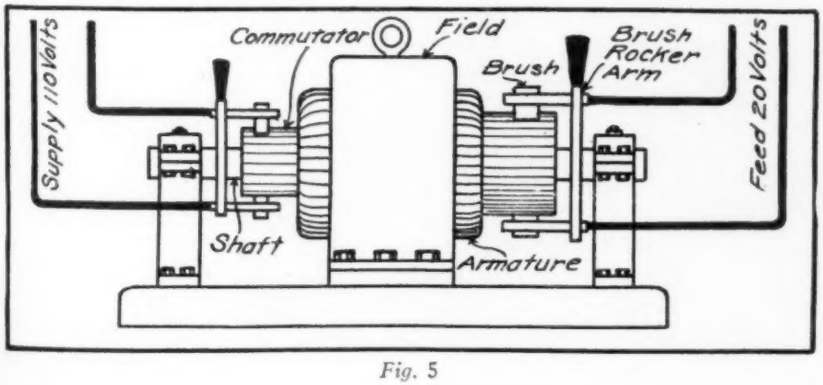


Fig. 5

Bernz Puts Big Torch and Furnace Stock at Frisco

San Francisco, Cal.—Stocks of Otto Bernz Co., Inc., "Always Reliable" furnaces and torches which have been maintained at the company's San Francisco warehouse recently have been greatly increased so that all orders from the Pacific Coast trade may be completed from the west coast source of supply. With the new lineup of stock orders in that part of the country can be filled considerably earlier than heretofore when a part of the shipment was made by rail or boat from the company's factory at Newark, N. J.

Albright, Hawthorne Plant Builder, Dies at New York

New York City—Henry Fleetwood Albright, vice-president in charge of manufacturing and a director of the Western Electric Co., died at Memorial Hospital May 11th, after an illness of several months. He was fifty-eight years old.

Mr. Albright was largely responsible for the upbuilding of the Hawthorne Works of the Western Electric Co. at Chicago. Mr. Albright's outstanding contribution was in scientific factory planning and management. At the time of his death he was head of all the company's manufacturing and plant engineering activities.

Mr. Albright joined the Western Electric Company in 1892 as a salesman of electric light and power apparatus in Chicago. Two years later he was transferred to New York to the construction department, and in 1897 he was made plant engineer of the New York factory. His brilliant success which was the result of natural aptitude and inclination toward this work led to his advancement in 1899 to the general managership of the New York shops.

Mr. Albright was elected a vice-president in 1917, and a member of the board of directors two years later. Since 1923 he had served as vice-president in charge of manufacturing and plant engineering.

Middle States Utilities Merges in Iowa and Missouri

Cedar Rapids, Ia.—Middle States Utilities Co., headed by John A. Reed, for many years president of the Iowa Railway and Light Co., has merged 26 exchanges in southern Iowa and northern Missouri into a property having 10,500 stations. Among the Iowa points affected by the deal are Leon, Grand River, Princeton, Lamoni, Garden Grove, Lineville, Blyedale, Leroy, Weldon, Decatur, Pleasanton, Davis City, Sidney, Randolph and Tabor. Missouri towns in the merger include Bethany, Princeton, Kahoka, Memphis and Unionville.

Texas Sets Eight District Meeting Dates

Dallas, Tex.—Places and times for eight district meetings of the Texas Independent Telephone Association have been set tentatively as follows:

Corpus Christi, June 17 and 18.
San Marcos, July 15 and 16.
Waco, August 10 and 11.
Memphis, August 25.
Dallas, September 14 and 15.
Tyler, October 19 and 20.
Brownwood, November 17 and 18.
Lufkin (date to be selected).

Signal Specialties Grow Into Larger Quarters

New York City.—Signal Engineering & Mfg. Co. has moved to 154 W. Fourteenth street, where it will enjoy greater capacity conveniences for accommodating its growing trade. Among its other specialties are the Klaxon Telephone Extension Relay and Signal Horn already quite well known to telephone companies.

Rochester, Ind.—Public reception held by the Rochester Telo. Co. drew a large number of interested visitors. The event got good newspaper publicity and proved a complete success.

DeKalb, Ill.—DeKalb and Rock River telephone companies have been merged, effective July 1.

London Grows at Rate of 1,000 Telephones Weekly

London, Eng.—On March 31 there were 486,800 telephone subscribers in the London area, and they were increasing at the rate of 1,000 per week.

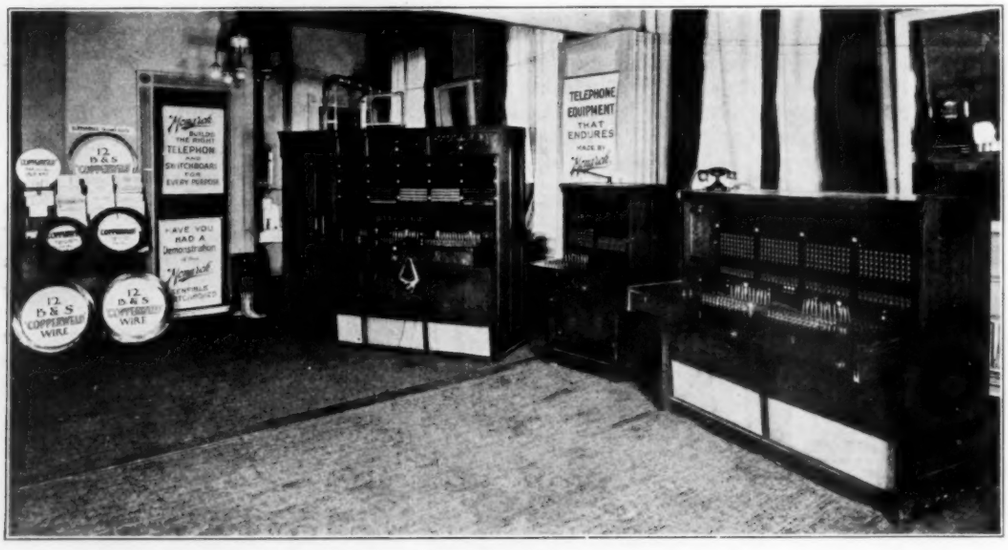
New Monarch Developments on Display at Rochester

Rochester, N. Y.—Monarch Telephone Manufacturing Company's exhibit at the convention of the Upstate Telephone Association of New York showed clearly the new developments and advancement Monarch has made in the manufacturing of telephone and switchboard equipment during the past year.

At the right of the accompanying view of the Monarch exhibit is shown the new combination magneto and common battery switchboard. This board may be installed with magneto equipment and at any time converted to common battery without any rebuilding of the board. On top of this combination board is shown Monarch's newest type telephone, the Como-Fone, a common battery instrument, or the Magno-Fone, a local battery instrument. It is the ideal telephone for the office or home Monarch says. The transmitter and receiver are combined in a single unit.

The switchboard in the center of the picture is Monarch's new 150 line magneto switchboard having key shelf supervision. This type of supervision provides operator efficiency of the magneto switchboard equal to common battery operation. To the left is Monarch's latest development, which is known as the unit position sectional type switchboard. This board will meet all requirements for future expansion, its makers state.

To the extreme left are Copperweld Steel Co. products which are recognized by many telephone companies as the standard for telephone construction work. The monarch Telephone Manufacturing Co. has been recently appointed distributor of Copperweld "Ecco Brand" insulated twisted pair drop wire, telephone line wire and ground rods to the independent telephone trade direct and through jobbers.



Monarch Makes Interesting Display at Up-State Convention

London, Eng.—On March 31 there were 486,800 telephone subscribers in the London area, and they were increasing at the rate of 1,000 per week.

The Telephone at the Centennial

ONE hundred years after the signing of the Declaration of Independence, the infant telephone was first exhibited at the Philadelphia Exposition.

Since the dawn of civilization, mankind had sought means of communicating over distances which unaided human speech could not bridge. Drums, signal fires, swift runners, the pony express, and finally the electric telegraph were means to get the message through. It remained for the telephone to convey a speaker's words and tones over thousands of miles.

"My God, it talks!" exclaimed the Emperor of Brazil before a group of scientists at the Philadelphia Exposition, as he heard and understood the voice of Alexander Graham Bell, demonstrating the new invention.

Today, after a brief half-century, the telephone lines of the Bell System have become the nerves of the nation. The telephone connects citizen with citizen, city with city, state with state for the peace and prosperity of all.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

BELL SYSTEM

IN ITS SEMI-CENTENNIAL YEAR THE BELL SYSTEM LOOKS FORWARD TO CONTINUED PROGRESS IN TELEPHONE COMMUNICATION

Creosoted Pine Pole Data Shows Users' Experience

By H. E. BRAUNIG*

(Supt. Transmission and Distribution, Eastern Texas Electric Co.)

In recent years there has been a marked expansion in the use of creosoted pine poles throughout the entire country. A quite thorough knowledge of these poles has developed through the studies that accompanied this increase, and answers possessing a high degree of accuracy are available to questions regarding their service. This paper endeavors to present these recent studies in summarized form. The sources of data will be found in the accompanying bibliography. Throughout the report the raised numbers refer to the biblography, wherein each reference is given fully so that it may be obtained if desired. The writer also cites actual experiences of the company with which he is connected in the use of creosoted pine poles, in various types of service over a period of fifteen years.

"Treated" pine poles is taken to mean "creosoted" pine poles, inasmuch as no preservative other than creosote is of commercial importance for pine pole preservation.

Strength of Creosoted Pine Poles

Strength is mentioned first because of its importance in line construction and because it is an outstanding characteristic of creosoted pine. The most recent authoritative strength tests on wood poles were those conducted by the American Telephone & Telegraph Co. in 1924.[1] The United States Forest Products Laboratory issued a bulletin on the same subject in 1923.[2] The most comprehensive discussion of the whole strength subject is given in Department of Agriculture Bulletin 556.

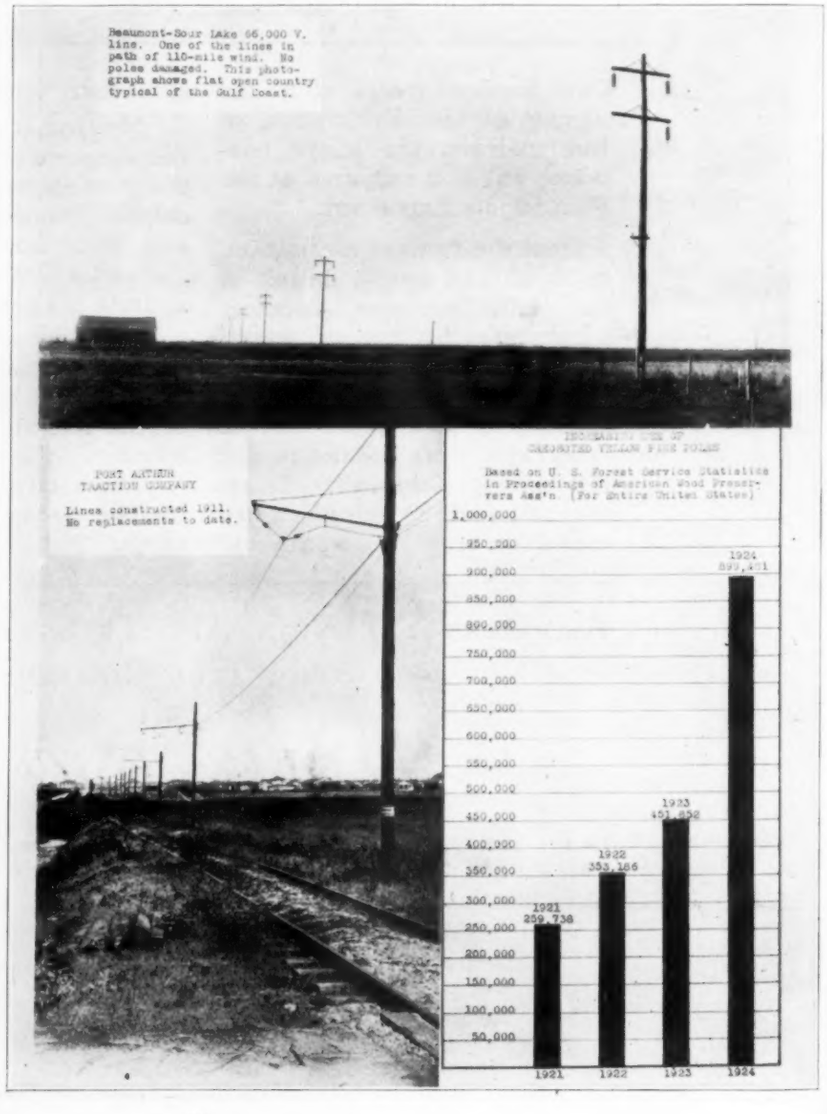
Each of these authorities found that pine is the strongest of the pole woods. Bulletin 556 lists it as 44 per cent greater in strength than the next strongest species, and this comparison was verified by the work of the Forest Products Laboratory. The A. T. & T.'s results have not yet been published. It is known, however, that in these tests also, pine proved the strongest of the several woods tested.

In line construction practical advantage is taken of the above in one of two ways—either by using smaller poles, or by using longer spans than when building with woods of other kinds. Our experience with creosoted pine began in 1911. Three years ago we adopted it exclusively. In general, we now use all poles one inch less in top diameter than formerly when other species were used.

A fact of equal importance is that creosoted pine maintains its strength over a long period. Tests, some of which were made during the last eighteen months, on creosoted pine poles twenty-seven years old showed no decrease. All evidence indicates that as long as the wood is preserved against decay the original strength is undiminished.

We had a striking example of this at Beaumont (Texas) on March 30, when a cyclone hit in that vicinity. The wind attained a velocity of 110 miles an hour, and due to the flat open country there was nothing to break its force. Damage of all description within the city limits of Beaumont alone amounted to one-half million dollars. Our properties were in the midst of this storm and though a great many wires and some 60 odd poles were broken, there was not a single broken creosoted pine pole—this in spite of the fact that some of the lines were installed as far back as 1911, and were in the direct path of the storm.

One section of our Beaumont-Liberty 66,000-volt transmission line was in the



**Read before sixth annual convention of southwestern division of the National Electric Light Association.*

direct path of this storm and at right angles to it, and although some of these poles were blown over to an angle of approximately 40 degrees, and some of the conductors broken due to the lack of guys, there was not a single broken or split creosoted pole in this section. This line is constructed on 55-foot creosoted poles, and a section of same is shown in the accompanying picture. We feel that this was entirely due to the strength of the creosoted poles, inasmuch as practically everything in the path of the storm, which blew approximately 110 miles an hour in this section, was wrecked; trees being up-rooted and twisted, and houses being demolished.

Life of Creosoted Pine Poles

This has been variously estimated as from twenty-five to forty years. The Pennsylvania Electric Association, overhead systems committee report, 1923[3], gives the anticipated life as thirty-five years. A recent paper by the Carolina Light and Power Co., "Characteristic and Cost Data," attributes a life of forty years. One of our oldest lines, between Port Arthur and Beaumont, was built in 1912. In its construction 652 poles were used. To date three of them have been replaced due to decay caused, as far as can be determined, from abrasions, there being practically no decay at the ground line or top. Following the recent storm various sections of this line were examined and found to be in splendid condition at the present time.

A line between Dallas and Sherman, Texas[5], built in 1909, and containing 2400 poles, has never had a replacement.

Poles in a test line placed by the A. T. & T. Co. in 1898 are in use today and the latest published report states that there are less than 10 per cent replacements. When, recently, it was decided to remove some of these 27-year-old poles to determine their strength, officials of the above company made this comment: " . . . these poles would have given at least 35 years service in their former location, where on the Gulf Coast they were exposed to the most severe conditions possible."[6]

In examining these old lines the outstanding fact is that the poles are apparently about as good as they ever were. The wood is preserved by the creosote and as long as this wood stays sound there seems to be no deterioration.

It might also be pointed out here that the above deals with poles which were treated fifteen to thirty years ago. The science of timber preservation, like other sciences, has advanced during these years. There is no doubt that the present-day application of the treating process is better regulated and more scientifically handled, and that the quality of the preservative oil is better controlled than ever before. Knowing this, it seems safe to assume that the treated pole itself is an even better product than we have heretofore obtained.

Conductivity

The overhead systems committee of the Southwestern Division presented its report at the 1922 meeting. The summary of that report is presented below along with the conclusions from two more recent studies on the same subject. One was made in 1923[7] by the conductivity committee of the American Wood Preservers' Association, and the other on the use of joint poles represents a study made in 1924 by the Southwestern Bell Telephone Co.

Summary of 1922 N. E. L. A. Committee Report

The conductivity of creosoted poles appears dependent on these factors:

Amount of moisture in poles if same is over 18 per cent.

Period of seasoning after treatment.

Percent of turpentine and rosin left in poles when treated, if any.

The hazard to the lineman is reduced (for voltage under 6600) when the creosoted pole has been allowed to season for ninety days or more after treatment.

It is to be noted that conductivity of these poles varies somewhat with the moisture content.

It is also interesting to note that the dry, untreated pole shows about the same results as the treated pole immediately after treatment.

This committee suggests that methods of seasoning poles after treatment be provided which will give the same results as allowing the pole to season in the yard for two months or more.

Summary From American Wood Preservers' Association Conductivity Committee, 1923

"Poles—Your committee has decided that for all practical purposes the conductivity question as related to poles holds no interest for the following reasons:

"1. The distribution engineer is concerned with insulator and crossarm resistance, the pole resistance forming but a small fraction of the circuit to the ground.

"2. Creosote is the preservative in general use for pole preservation, and the experimental data show that it increases resistivity of timber.

"3. Steel poles and crossarms are in common use on transmission lines."

Summary of Southwestern Bell Report, 1924

"The question is sometimes raised as to whether untreated poles are more suitable than treated poles for joint use with electric companies. This bulletin indicates that pole resistances are lowest when the pole surfaces are wet and that under these conditions the resistances of treated and untreated poles are approximately the same. For these reasons, it is felt that as far as safe operating conditions and safety to linemen are concerned, treated poles are as satisfactory for jointly used lines as untreated poles."

White Ant and Woodpecker Attacks

On the Gulf Coast white ants are a serious problem, for the reason that they are one of the most virulent wood destroyers and once they begin work on a pole nothing can save it. It is not uncommon for them to completely riddle an untreated pole of any kind in a year. Experience to date has shown creosoted pine as the only pole that successfully withstands their attack for a long period of time and this is due, not to the wood itself, but solely to the fact that the method of treatment forces the creosote deeply into the wood.

An example of the seriousness of these attacks was brought out in the recent cyclone at Beaumont. Some untreated poles on our Pine Street power lead broke during the storm—a creosoted pine pole stopped the break. When we examined these broken poles we found them completely hollowed out at the ground line—the work of white ants. They were installed less than four years ago. This has been quite a common experience in Beaumont in the past ten years.

The government publication, "Tests of Methods of Protecting Wood Against Termites or White Ants"[8] recommends creosote as the best preservative, saying:

"The most effective preservative in protecting timber to be set in the ground from attacks by termites is coal tar creosote . . . Impregnation by the full cell process with coal tar creosote renders wood resistant for at least 25 years."

Regarding woodpeckers: These birds are not numerous in many sections of the southwestern territory. There are places, however, where they do serious damage, weakening poles both by the removal of wood, and by making pockets which hold moisture and promote decay. It is sufficient simply to say that experience has shown the creosoted pine pole highly resistant to these pests.

Fire Resistance

The literature on the fire hazard of creosoted wood contains two outstanding references. One was published in 1924 by the American Railway Bridge and Builders' Association[9], and the other, an older one, by the National Fire Protection Association.[10] Both show that creosoted wood when new is more readily inflammable than untreated wood, but that when it becomes older it is less inflammable than untreated wood. On the whole both studies conclude that creosoted poles, and creosoted timber in general, are less subject to damage by fire than untreated wood.

This fire resisting quality has been explained on the basis that when creosoted wood is ignited a chemical decomposition of the creosote takes place during the

burning. This decomposition deposits a protective coating of carbon on the wood and to some extent protects it.

Statistics

In the beginning of this report mention was made of the increasing use of creosoted pine poles. Statistics compiled by the Forest Service show twice as many used in 1924 as in 1923, with the result that more of them went into service during that year than poles of any other kind. Though the government's figures are not available for 1925, all evidence indicated that this rate of increased use prevailed during that year.

The vast majority of these poles were treated by the 8-pound Rueping Empty Cell Process, the 12-pound Bethel Full Cell Process and the Lowry Empty Cell Process. These three methods are practically the standards.

Cost

It is not possible to give definite figures on cost, due to the fact that each of the companies that have made cost studies have based their figures on specific conditions applying only to themselves—that is, freight rates, installation and labor costs, climatic conditions affecting anticipated life, etc., all of which are necessarily different for each company.

Two comparative cost studies have been made in the last twelve months, one by Mr. C. V. Merriam,[12] engineer of the Eastern Texas Electric Co., and another by the Carolina Light and Power Co.[4] Each of these show creosoted pine as having a decidedly lower annual cost than that of other poles.

Summary

This report is summarized as follows:

1. Strength:

Pine is the strongest of the pole woods. Its strength is lasting, there apparently being no reduction even after long periods of service.

This fact has its application in the use of smaller poles or fewer poles per mile in creosoted pine construction.

2. Life:

Variously estimated as being from 25 to 40 years. Ultimate average not yet definitely established.

3. Conductivity:

Not increased by creosoting.

4. White Ants:

Most resistant of wooden poles due to deep penetration of creosote which is a toxic to white ants.

5. Fire Resistant:

Studies have shown creosoted pine poles resistant to fire. References named in the bibliography cite examples of lines showing this property of fire resistance.

6. Use:

Increasing rapidly in all kinds of service.

7. Cost:

The results of available cost studies differ widely for different companies, but are uniform in showing pine as most economical when compared with poles of other kinds, for usual types of service.

Bibliography

[1]Tests on Pole Strength. By American Telephone and Telegraph Co., 1924. (These results have not yet been published. They are to be presented at a later date before one of the Engineering Societies.)

[2]Results of Some Strength Tests on Wooden Poles. By T. R. C. Wilson, U. S. Forest Products Laboratory, Madison, Wis.

[3]Southern Pine Poles. 1923 Report of Overhead Systems Committee. Pennsylvania Electric Association, Eastern Geographic Division, N. E. L. A.

[4]Characteristic and Cost Data. April 1, 1925. By Distribution Dept., Carolina Light & Power Co.

[5]Report of Inspection of Preservative Treatment, Dallas-Sherman Toll Pole Line. 1921 Southwestern Bell Telephone Co., Dallas, Texas.

[6]Wood Preserving News. September, 1925.

[7]Report of Conductivity Committee. In Proceedings of American Wood Preservers' Association, 1923, pp. 362-363.

[8]Tests of Methods of Protecting Woods Against Termites or White Ants. U. S. Department of Agriculture Bulletin No. 1231. By Thomas E. Snyder.

[9]The Fire Hazard of Treated Timber. Proceedings of American Railway Bridge and Builders' Association, October, 1924, pp. 152-153.

[10]The Creosoting Industry with Relation to the Fire Hazard. Quarterly of the National Fire Protection Association, April, 1918, pp. 399 to 413.

[11]Quantity of Wood Treated and Preservative Used in the United States in 1923. Ibid 1924. Published by R. K. Helphenstine, U. S. Forest Service in cooperation with American Wood Preservers' Association.

[12]Report on the Suitability of Concrete Poles for Use by Light Power and Street Railway Companies. By C. V. Merriam, Eastern Texas Electric Co., Beaumont, Texas.

Bowen Elected Georgia President at Interesting Meeting

Atlanta, Ga.—Georgia Association of Independent Telephone Companies honored Wm. R. Bowen of Fitzgerald by naming him its president at the annual meeting held here. The Georgia convention drew a good attendance, there being a number of visitors from surrounding states, in addition to the native telephone men, to take part in a practical program.

Representatives of the national Independent association played prominent roles in the convention activities. F. B. MacKinnon, chief of the national Independent body, spoke on the relations of the two telephone groups and repeated his statement made before other state conventions to the effect that two strong units must be preserved for the general good of the industry and public. A. C. Cragg of the Tri-State and A. L. Staderman, chief engineer of the Citizens' Independent of Terre Haute, two of the nationally known Independents, spoke on accounting and engineering standards, respectively. Following both of these addresses there were lively discussions. An accounting conference for the southern division featured the Wednesday afternoon session, the presentation and analysis of the U. S. I. T. A. member companies' figures being made in the usual manner.

A plan for bettering service, based on a study of the customers' viewpoint, was presented by Carroll O. Bickelhaupt, vice-president of the Southern Bell. C. M. Candler, ex-chairman of the Georgia Public Service Commission, went into the basic principles of regulation in an address on "Why the Public Regulates You." Mr. Candler told of the ever present effect of this public regulation on service, financing, rates and other phases of utility operation.

A committee consisting of J. P. Manning, J. L. Mathews and W. R. Hunter, was appointed to work out details of district meetings which the association plans to hold during the coming year.

Illness prevented the appearance of the newly elected president at the meeting. Mr. Bowen's team-mates in the new administration are:

First vice-president, J. M. Dent, Douglas; vice-president, J. L. Kirk, Moultrie; vice-president, C. D. McCutcheon, Dalton; treasurer, J. L. Mathews, Statesboro; secretary, J. P. Manning, Fitzgerald, and general counsel, J. Prince Webster, Atlanta.

Directors elected are: Wm. R. Bowen, Fitzgerald, J. L. Kirk, Moultrie, J. L. Mathews, Statesboro, W. D. Horton, McRae, W. M. New, Washington, A. A. Fincher, Canton, J. I. Stanford, Mt. Vernon, J. T. King, Milledgeville, J. M. Dent, Douglas, C. D. McCutcheon, Dalton, J. P. Manning, Fitzgerald, W. R. Hunter, Quitman, W. A. Jennings, Hawkinsville, Ed. M. McKenzie, Montezuma, and J. W. Southall, Cairo.

Bell Announces Five National Rewards for Heroism

New York City.—Three women operators and two men are named for silver medals and cash awards of $250 each by the national committee of award working under the terms of the Vail Memorial Fund for recognizing noteworthy public service by employees of the Bell system.

Those receiving this year's awards are: Mrs. Josephine L. August, Night Operator, Dowagiac Telephone Co., Cassopolis, Mich., Mrs. Mary Regina Smith, Operator, Fabens Telephone Co., Fabens, Tex., Everett C. Nelson, Installer Repairman, New York Telephone Co., Niagara Falls, Emory Daniel Stine, Lineman, Bell Telephone Co. of Pennsylvania, York, Pa., Ruby La Verne Wilson, Operator, Southwestern Bell Telephone Co., Washington, Ark.

LINE AND DESK

MAINTAINING TRANSMISSION IS BIG JOB

The magnitude of the job of maintaining satisfactory transmission on a large toll system is told by H. L. Ballard Supervisor of Transmission Methods of the Michigan Bell Telephone Co. in the Mouthpiece. The Michigan Company now has over 58,200 miles of toll circuit, an increase of 15,000 miles since 1922, and the methods of keeping the service up to standard are told in part by Mr. Ballard as follows:

"To safeguard our service, which has become more extensive than ever before, due to the developments of recent years, a comprehensive program of tests must be carried out upon our plant to check its condition from a transmission standpoint. This program includes tests upon both the equipment within the central offices, upon P.B.X. switchboards and upon the toll circuits and associated equipment. It requires the services of the local testmen and equipment men at all offices involved, who make tests according to a regular routine and involves tests of a more specialized nature by the division transmission testers.

A brief summary of our transmission testing program may be of interest. It includes these items:

Transmission tests on local and toll circuits within central offices.

Transmission tests on P. B. X. switchboards.

Transmission tests on toll circuits.

1925 MICHIGAN BELL TRANSMISSION TEST RECORD

Summary of the number of transmission tests made during the past year:

Transmission Tests on Central Office and P. B. X. Circuits	**67,321**
Transmission Tests on Toll Circuits	**1,118**
Balance Tests on Circuits used with Telephone Repeaters	**354**
Insulation and Balance Tests on Toll Circuits	**17,465**
Noise Tests on Toll Circuits	**6,650**

Routine tests upon telephone repeaters.

Balance of toll circuits used with telephone repeaters.

Balance of composite sets.

Insulation and balance tests on toll circuits.

Noise and cross-talk tests on toll circuits.

As a slight indication of the effort which has been expended during 1925, in carrying out this program to keep our facilities up to the standard of efficiency necessary for satisfactory transmission, the table on this page has been prepared to show the number of tests which have been made on certain of the phases of the program for which data is available.

To keep pace with the increasing demands for adequate maintenance of our facilities from a transmission standpoint during the past three years, the force directly engaged in this work has grown from six in 1922 to 18 at the close of 1925. At the present time, everything indicates that this force will be even busier this year than it has been during the one just closed, and that a summary of its accomplishments will show substantial gains over the showing of the year just ended."

BUGS WE HAVE SHOT.

A few days ago I received a trouble ticket reading, "456-J, Bell Does Not Ring." Upon inquiring of the operator, I learned that the party had placed a long distance call and that the operator could not get the subscriber back on the line when she had the connection ready. I tried to call the subscriber but got no answer, so went to the house. The lady told me that the bell did not ring, so I signalled the operator and asked her to "ring J." The operator rang and I did not get it, so I looked in the bell box and found that the ringer was set to ring on "M" instead of "J." I again asked the subscriber what her telephone number was and she said 456-J. I could not figure out how the bell would be set to ring on "M" if the letter were "J" and so I looked up the number in the directory and, sure enough, the correct call was 456-M. The subscriber had given the wrong letter to the operator in placing her long distance call and had given me the same letter when I called to make the repairs. I called her attention to the mistake and I think she is still trying to figure out how she came to make it.—Contributed by W. P. Swarthout.

A PECULIAR ELECTRIC LIGHT CROSS.

Exchange Repairman Denney, Lawton, Okla., encountered a peculiar case of trouble recently when a subscriber reported that her telephone rang continuously. He found her to be on a four-party line, and after inspecting the terminal pole he found that no light wires were within four feet of the drops. Mr. Denney opened the drops and located the line with 110 volts on it, but everything seemed to be in the clear. However, pulling the light switch in the house cleared the trouble. The drop and ground wire from the subset were then opened, but he still got the 110 volts. It also was still in a charging condition after all the wires from the inside of the subset had been opened. Upon removing screws that held the subset on the wall it was found that the trouble was cleared. This substation was installed May 21, 1924, and after this period of time the insulation on the light wire broke down and got on the blue wood screw of the set, conducting the current to the 533-A metal subset.—Southwestern Telephone News.

WEAR RUBBER GLOVES

The following comment on the subject of wearing rubber gloves was made by a St. Louis line foreman at a recent safety meeting of supervisory officials of the Southwestern Bell Telephone Co., reported in Southwestern Telephone News.

"After the accident, it's too late. All there is to do is write in the report, *he had rubber gloves but did not use them.* If someone had checked up on that man beforehand the accident might have been prevented. The day he was hurt was not the first day he neglected to use his gloves. He had grown careless. When men will not be careful, we ought to go to the mat with them.

"I know of one case where a man was killed where I am sure he thought it was a disgrace to wear gloves. Some men think the use of rubber gloves indicates inexperience and lack of knowledge. We've got to discourage such foolish ideas.

"Any man who laughs about the use of safety devices should be reported and treated as dangerous."

BEES AND BLAZE MAKE MISERY FOR CLIMBER

The gent who was marooned between the devil and the deep blue sea was real comfortable compared to the ambitious lineman of the telephone company, who acquired a profound respect for the "Keeper of the Bees" yesterday afternoon.

This hero was caught between two fires, one of them concealed in the tails of a swarm of busy bees. Stranded half way up a telephone pole, he was subjected to a hostile aerial bombardment and to a concentrated attack from the rear at the same time, and he had no defense against either. He jumped from the frying pan into the fire and back again, with no time out for peace negotiations.

Trouble developed Thursday on a telephone line near Second and Arch streets. The company sent a man to investigate, and soon the "trouble-shooter" discovered that a colony of bees had nested in a cable box on the corner and the little rascals were busily making honey to the detriment of the service.

The first lineman contented himself with making a report of his findings. He left the industrious insects in undisturbed possession of the cable box, and declined pointblank to assume the role of home-wrecker.

Yesterday the company sent out another man, who had greater courage or less knowledge of the habits of bees. This man mapped out a campaign which he deemed would be safe and successful.

Equipped with a match and a newspaper, he clambered up the pole, sinking his sharp spikes into the soft wood. Under the cable box, he belted himself securely and proceeded to carry out his dastardly plan.

He set fire to the paper and held it close under the habitat of the unsuspecting bees. When the smoke and flames crept into their domicile, there issued an angry "Bzzzz-bzzzz," which freely translated means, "Gwan, big boy, before we sit upon yuh." The warning was ignored, so the queen dispatched a couple of warriors to do their stuff. They did. Then the lineman took notice.

He dropped the blazing paper and started downward with more haste than dignity. Alas, his retreat was cut off. The paper fell into a pool of highly inflammable oil, which had been poured around the foot of the pole to kill the grass. The blaze leaped high and licked hungrily at the lineman. A tongue of flame landed a scorcher where it would do the most good, and the trouble-fixer ascended the pole in a way that made the squirrels envious.

He was met by a whole platoon of thoroughly infuriated bees, which evidently meant to do battle in defense of their home—a fight to the finish. Down went the lineman once more. A spurt of flames and black smoke sent him upward again.

Well, finally a sympathetic spectator called the fire department. Companies Nos. 1 and 8 responded and put out the blaze. The harassed lineman plopped to earth, a sorry figure.—Clipped by J. P. Whitson, from Little Rock (Ark.) Gazette.

KRAEUTER & CO.

Diagonal Cutting Pliers. No. 2601, 6 in. $1.65

Radio and Switchboard Pliers. No. 1561, 6½ in., $2.00

Kraeuter Lineman's Pliers, No. 2801, 8½ in., $2.75

EVERY pair of Kraeuter Pliers is hardened with extreme accuracy.

Their cutters are *hard* but not brittle.

Their rugged lap-joints *fit close*, and hold the cutters true.

Every pair is tested at the factory for *strength, toughness* and *cutting power.*

KRAEUTER PLIERS

KRAEUTER & CO., Newark, N. J., Established 1860

A CIRCUIT FOR TESTING CLEARING OUT DROPS

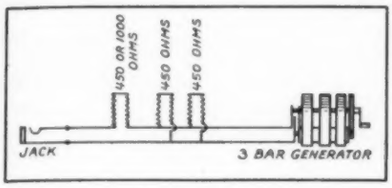
In the January issue of TELEPHONE ENGINEER, I read with interest an article by John M. Walshe on magneto switchboard maintenance.

I have been using the simple testing circuit diagram for a number of years and have found it to be an excellent one in determining the condition of keys and cords.

Presuming that jack No. 5 is connected to the power generator for the purpose of determining the condition of clearing signal in cord circuit. I have tried this arrangement and others connected to the power generator and have not found them satisfactory, as they do not test the drop under service conditions. The drops will operate under the test, but will not under all circumstances when connected to subscribers' circuits, especially when connected to short party lines.

I am enclosing herewith a circuit ar-

rangement which I have found very satisfactory and which may be of benefit to others. Drops in the cord circuit adjusted to work with this test will work



Clearing Test Circuit.

more satisfactorily. By inserting plug in jack, giving the crank a quarter or half turn, drop should be adjusted to operate. In place of the two 450 ohm or 500 ohm coils bridged across this circuit, one might use a coil of about half the resistance of one of these in place of the two.—Contributed by W. S. Low, Eastern Townships Telephone Co., Coaticook, Que.

Lincoln, Neb.—Lincoln T. and T. Co. has bought exchanges at Western and Swanton, Neb., from the Western Telephone Co.

Chillicothe, Mo.—C. E. Tracey, who also owns the Camp Point, Ill., Telephone Co., has purchased the local telephone property.

Protect cord service against warm weather troubles

Vacation periods, replacement of the girls who get married, and moisture from warm, hurrying hands, combine to put a heavy strain on cords during the coming months.

Runzel-Lenz cords help service over this difficult period for they are built to withstand inexperienced and harsh handling. For nearly a quarter of a century Runzel-Lenz has been specializing in switchboard and telephone cords. We have constantly developed methods and materials that lengthen cord life and assure a continuity of perfect cord service.

The perspiration of summer, the jerks and twists of girls who still have a lot to learn about cord handling, and all of the other miseries to which switchboard cords are heir, are offset by the exclusive construction of Runzel-Lenz cords. Better lay in a supply of them right now, and see how they cut down your cord costs.

Complete details of the right Runzel-Lenz cord for any telephone use will be rushed to you on request.

RUNZEL-LENZ
ELECTRIC MFG. COMPANY
1751-75 North Western Ave.,
CHICAGO, ILL.

WHAT DO YOU RECALL OF "'WAY BACK WHEN"?

Leslie H. Jenks, division plant superintendent of the Northern New York Telephone Corp., has started something. Mr. Jenks, in a reminiscent frame of mind, put down a few of the interesting details that pioneer telephone men harbor in their memories, and his thoughts look so good to TELEPHONE ENGINEER that we hereby invite all of the pioneers to send us some paragraphs putting forth the memories of the bygone days.

These recollections will serve to emphatically and intimately remind us all of the tremendous advance made by the telephone industry in its first half century.

As a starter, do you remember 'way back when—

The first telephone cables had parallel single cotton covered wires, paraffined and covered with a lead sheathing which was protected by a heavy weatherproof braid?—L. H. J.

A rural line extended from telephone to telephone in series, until a coil of wire was thrown in a brook and that was the end of the line?—L. H. J.

The brass shutters about one inch square were used as switchboard signals and that experienced operators knew the number of line by sound of falling drop and seldom looked at them in answering?—L. H. J.

When the disconnection of a gas meter in a large office building caused more line trouble than the failure of a toll lead at the present time, from the fact that all lines were grounded and the gas pipe was the most convenient ground connection?—L. H. J.

A toll line could be financed by selling enough coupon books in each town to build the line to reach it?—D. A.

"Do you remember when an Independent telephone man was ostracised if it were reported that he talked to a Bell official, or even a Bell employe?"—G. H.

Bruce V. Hill in Consulting Engineering Work

Chicago, Ill.—Bruce V. Hill, for 16 years one of the engineering staff of the Illinois Bell Telephone Co., has entered the consulting telephone engineering field. Mr. Hill's offices are at 1331 Monadnock Block, Chicago. He will care for construction, maintenance, inductive interference, transmission and other problems of telephone engineering practice.

Following study in the United States and abroad, Mr. Hill was in charge of engineering instruction at the universities of California and Kansas.

During his service with the Illinois Bell, Mr. Hill was responsible for a number of inventions and studies.

Strong Factories Vital to Independent Success, New York Is Told

Rochester, N. Y.—"We cannot have a strong Independent group unless we have strong Independent factories and distributing houses." This warning was handed to the Up-State Telephone Ass'n of New York at its annual meeting here, when Charles Deering, secretary of the national Independent organization, read, in the absence of its author, the address on "The Independent Factory a Part of the Independent Group," which was written by F. B. MacKinnon, president of the United States Independent Telephone Ass'n. The MacKinnon address featured a big and resultful convention and traffic conference.

The Independent chieftain urged that the Independent operating companies go the limit in supporting the Independent manufacturing and distribution interests. He questioned the actions of some Bell representatives as being contrary to the Bell commitment to the policy of maintenance of a strong Independent group.

Up-State New York returned to office its last year's administration headed by George R. Fuller, president of the Rochester Telephone Corp. The association's affairs are in excellent shape and its performance during the past twelve months, in helpfulness of district meetings and other activities plainly indicated that the member companies were harvesting the benefit of the association, according to the evidence of the report of Vice-President and General Manager J. G. Ihmsen.

K. S. McHugh, general commercial manager of the New York Telephone Co., spoke on "The Commercial Job of Today" and stressed the mutuality of interests shared by Bell and Independent companies in telling of the effect of shortcomings of either of the factors upon the reputation of the innocent party in the industry. Mr. McHugh detailed the methods of handling commercial work in the most satisfactory manner.

Accounting got its inning in the address of Walter J. Fitzpatrick, chief accountant of the New York Public Service Commission. Mr. Fitzpatrick spoke on "Regulation of Public Utilities and Accounting in Connection Therewith." There was much enlightenment concerning the proper practice in New York state given to a closely interested audience by Mr. Fitzpatrick.

"Public Utilities and Public Education" was the subject treated by Dr. Herbert S. Weet, Rochester's superintendent of public schools. Dr. Weet told of ways of convincing the public of the utilities' desire to serve well and dwelt upon the employee contacts as the foremost item in this work.

Sergius P. Grace, commercial development engineer of the Bell Telephone Laboratories, Inc., told of the Bell system's work in research and engineering during an instructive and interesting address on "Science and Research in Telephone Development." Mr. Grace spoke of the work the Bell laboratories have been doing recently in connection with loading coils, repeaters, public address and radio broadcasting system, multiplex telephony, picture transmission over telephone wires, "Permalloy" loaded ocean cable, artificial larynx, the electrical stethoscope, electrical recording and reproducing, audiophones and audiometers.

An open forum session presided over by John P. Boylan, vice-president and general manager of the Rochester Telephone Corp., provided one of the convention's high spots. The discussions treated of a number of problems in engineering, traffic, commercial and plant work, among which were

"What factors are taken into consideration in determining a rural rate for service?"

"Do you receive many applications for service and what is the comment of the public where there are no facilities available?"

"What is done by the operator when she encounters poor transmission on a long distance call?"

"Do all the smaller companies use the standard multiple markings on their switchboards?"

"Is it essential to gauge test magneto switchboard jacks, and if so, how often?"

"Should yearly inspections be made of station apparatus located on rural lines?"

"What are the principal advantages of common battery service over magneto? How does maintenance compare?"

"Is it good business to incur expense in securing right of way permits for existing construction?"

During the meeting a well-attended operators' conference was held. Miss Marguerite P. Croake, traffic supervisor of the Northern New York Telephone Corp., presided over the four lively sessions. Many of the state's well-known operators presented papers at this conference.

Entertainment was furnished in abundance for the conventioneers. Charles P. Barnes, commissioner of railways, Rochester, spoke of the early history of wire communication. He was closely identified with the pioneering days and drew from his experience in making an entertaining address. The Rochester Telephone Corp. and Stromberg-Carlson conducted a tour of Rochester for the visitors. Stromberg and the Kellogg Switchboard and Supply Co. were hosts at luncheons for the convention attendants.

Officers re-elected by the Up-State New York Ass'n are:

Geo. R. Fuller, president, Rochester; J. G. Ihmsen, vice-president and general manager, Albany; G. G. W. Green, secretary, Johnstown; Chas. M. Beattie, Rochester; F. J. Brookman, assistant secretary, Rochester; J. P. Boylan of Rochester, B. H. Brooks of Plattsburgh, F. D. Fancher of Middletown, H. W. Fluhrer of Oneonta, G. R. Fuller of Rochester, G. G. W. Green of Johnstown, J. G. Ihmsen of Albany, L. H. Jenks of Carthage, H. P. McDonough of Newark, F. C. Saunders of Wellsville, W. A. Seely of Norwich and J. H. Wright of Jamestown, directors.

Monarch Is Copperweld Products' New Distributor

Chicago, Ill.—The Copperweld Steel Co., manufacturers of Copperweld wire products, and the Habirshaw Cable and Wire Corp., insulators of Copperweld products, announce that, beginning June 1, the Monarch Telephone Manufacturing Co. of Chicago will act as their distributors for Copperweld products to the independent telephone trade direct and through jobbers. This announcement is of importance to the telephone trade, inasmuch as it will now be possible to obtain genuine Copperweld products from either the Monarch Telephone Manufacturing Co. or their authorized jobbers. Very shortly the Monarch company will make an announcement listing the names of jobbers throughout the United States who will be in a position to supply Copperweld products.

The telephone industry, as well as the railway and electric light and power companies, is rapidly adopting Copperweld wire products as its standard, the Monarch company states. Copperweld is made by the molten welding process—copper welded on steel. Its makers point out that this welded construction is assurance against rust and corrosion. In the manufacture of Copperweld no reliance is placed upon such mechanical adhesion as may be obtained by rolling and drawing. The weld uniting the copper to the steel is a molten one, made in a large ingot. Galvanic action can not take place between the metals due to this molten weld.

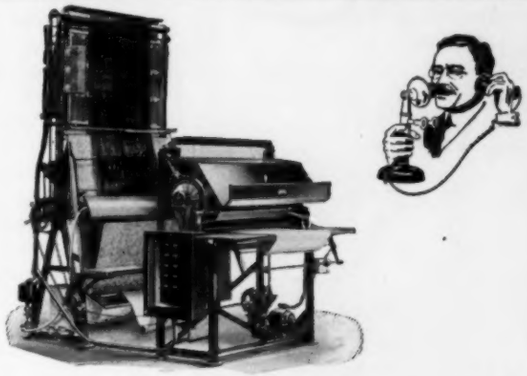
To those companies who are not already familiar with Copperweld the Monarch Telephone Manufacturing Co. offers a very interesting and instructive book giving in detail the method of manufacture, together with complete engineering information on Copperweld and all other types of wire. This book is of particular value to the telephone industry. A letter will bring the book.

For Maximum Service—Baker Contact Points

DEPENDABILITY and long life are the two essentials in a contact point. This "heart of the machine" should function evenly and steadily over long periods of time—it should not need replacement at frequent intervals.

Baker Contact Points are made with this principle always in mind and the name "Baker" assures that perfect performance, without constant renewal, which is the outstanding characteristic of a *good* contact point. Our contacts are made of Platinum, Iridio-Platinum, Silver and Special Alloys. There are sizes and types for all purposes.

BAKER & CO., INC.
54 Austin St., Newark, N. J.
NEW YORK CHICAGO



"Long Distance" Blue Print Runs on a "Short Rate" Basis

The PEASE Peerless Blue Printing Equipment is speedy—economical—simple in operation—and above all, stands ever ready to serve—to turn out at a moment's notice perfect blue prints in any quantity whenever you want them.

If your blue print requirements total a considerable quantity—this PEASE Peerless Machine will prove as indispensable to your drafting room as a telephone to your desk.

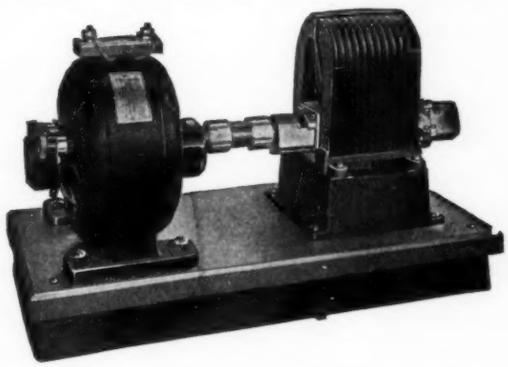
Ask for your copy of Catalog M-07, just off the press.

The C. F. Pease Company
807 N. Franklin St., Chicago, Ill.

Does Your Ringing Machine Cause Interference with Radio Reception?

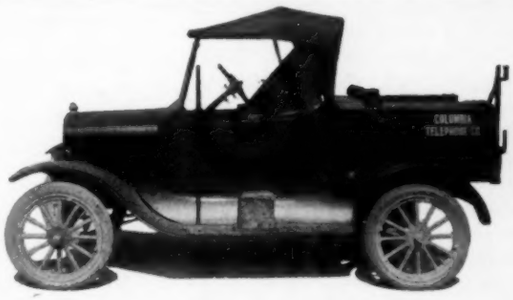
You can gain the good will of local radio fans and have BETTER RINGING SERVICE as well, by installing a

HOLTZER-CABOT
Magneto-Ringing Motor-Generator



We sell this Ringer with a guarantee.
Write us for details and prices.

The Holtzer-Cabot Electric Co.
125 Amory St., Boston, Mass. **6161 So. State St., Chicago, Ill**



Type SC-172

Cabinet Body for Ford Roadster

A STRONG, light-weight, convenient cabinet body used in connection with the standard Ford roadster. Soon repays its first cost. Standard equipment with some of the largest telephone and power companies. Equipment includes ladder irons and rear fenders.

Write for Bulletin No. 214 giving prices and full information

HOOVER BODY CO.
YORK, PENNSYLVANIA

New Type Magneto Equipment Installed at Sylvania (O.)

Sylvania, Ohio—The Sylvania Home Telephone Co. recently installed complete new central office equipment said by its makers to be the latest development in magneto switchboards. The installation consists of a two position lamp signal switchboard in which the line signals and jacks are multipled, a desk type toll switchboard, wire chief's cabinet and

floor type protector and distributing rack. The main switchboard is a distinct departure in the design of magneto equipment. The board is not a combination common battery and magneto, universal or convertible type, it is purely a magneto unit, yet it incorporates those practices found in the above mentioned types that have a direct bearing on the speed of operation, point out the manufacturers and installers, the Leich Electric Co.

The line signals are lamps mounted immediately above the answering jack and are associated with the multiple jacks on the lines that are multipled. Each line lamp is controlled by a ring down relay which in turn is restored when the call is answered. Multiple jacks in use have busy signals. While the arrangement of lamp and jacks conforms to present practice in obtaining greater flexibility in answering calls on boards of large capacity, it is unique when applied to magneto switchboards, and it is claimed that the advantages of call distribution are obtained without the expense usually involved to obtain this arrangement.

The supervision is also lamp with a semi-flash recall that immediately attracts the operator's attention. With the subscribers educated to ring off when finished with a conversation, the supervision is excellent, requiring practically none of the operators' time in listening in.

The toll board is standard desk type with the usual accommodations for filing and handling of toll service.

In the terminal room, the new distributing frame and test cabinet completes an installation that is well designed central office equipment.

Pennsylvania to Philadelphia, August 30-September 1.

Harrisburg, Pa.—The annual convention of the Pennsylvania State Telephone and Traffic Assn. will be held on Monday, Tuesday and Wednesday, August 30, 31 and September 1, in the Bellevue-Stratford Hotel, Philadelphia. The association says:

"By that time the Sesquicentennial will be complete in every detail and in full swing. These dates are also within the school vacation period which makes it possible for those having children to bring them to the exposition at that time.

"The convention sessions will be held in the North Garden, on the roof of the hotel and only one session will be held each day, in the morning, leaving the afternoon and evening open for your own amusement.

"It is our desire to make these three days real Independent Telephone days at the Sesquicentennial and therefore, we have asked every Independent Telephone Association in the United States to cooperate with us in urging their members to come to Philadelphia at that time. From the hearty response we have received up to this time, we believe our convention will have a decided National atmosphere."

J. B. Hoge, Independent Pioneer, Dies at Cleveland

Cleveland, O.—James B. Hoge, 59, one of the active organizers of the Independent telephone movement, died here. Mr. Hoge formed the Black River Telephone Co., now the Lorain County Telephone Co., in 1894. He was connected with the manufacturing end of the Independent business as president of the Automatic Signal & Appliance Co., and as manager of the Telephone Fire Insurance Exchange. In 1905 he was president of the National Telephone Association when it was merged with the Interstate Independent association. He headed the united group during the first year of its union and again in 1907.

Gary Buys Citizens Company at Terre Haute

Terre Haute, Ind.—Hart F. Farwell, president of the Citizens' Independent Telephone Co., announces that the property has been sold to Theodore Gary & Co. No change in the management or operation of the Citizens is contemplated, it is stated. Desire to divide the estates of the nine deceased members of the original syndicate of twelve owners was a prominent factor in the sale.

Chillicothe, Mo.—C. E. Tracy, owner ofthe Camp Point Telephone Co., recently purchased the local telephone property.

"I Beat This," Says the American Booth Man

O. Gullicksen, president of the Curchill Cabinet Co., one of the largest makers of telephone booths in the world, is the man who's shown using the telephone booth typical of Scandinavian installations. Gullicksen paid a visit abroad several

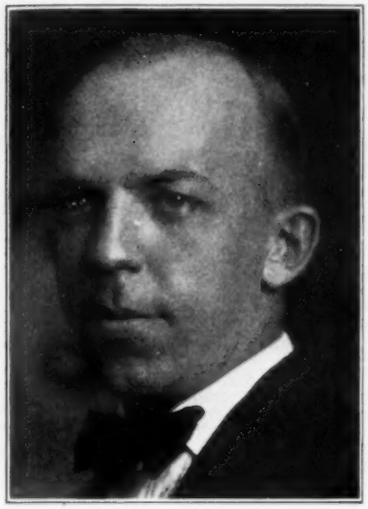
months ago and threw out his chest in rightful pride when he compared the foreign public telephone installations with those of the United States. About the only thing that can be said of the foreign layouts is that they keep the customers out of the sunshine, and they certainly are not one-two-twenty with the product that has played such a prominent part in the establishment of the Gullicksen fortune, so its owner will admit without being subjected to a third degree session.

Crane, Gary Executive, Resigns from K. C. Telephone

Kansas City, Mo.—J. G. Crane, vice-president and general manager of the Kansas City Telephone Co., resigns this position, effective July 1. Mr. Crane's work as president of the Diversified Investments, Inc., vice-president of Theodore Gary & Co., and other Gary interests, has grown to the extent that it forced a concentration of his able efforts.

W. C. Strehl, La Crosse (Wis.) Expert, in Equipment Work

La Crosse, Wis.—William C. Strehl, telephone expert, has entered the telephone field covering the states of Wisconsin, Minnesota and Iowa, with headquarters at La Crosse. Mr. Strehl, whose motto is "Service," has taken up the job of assisting the smaller exchanges with their equipment troubles. His experience with the La Crosse Telephone Co., by whom he has been employed for the past ten years, has fitted him well for this particular kind of business. Mr. Strehl was born in La Crosse, Wis., March 27, 1894, and attended the public schools of that city; also, the La Crosse County Agricultural School. He entered upon his telephone career in 1911 as helper in installing the new exchange at La Crosse. In 1912, he went west and was engaged as installer with the Western Electric Co. in many of the large exchanges in San Francisco, Portland, Seattle, Tacoma and other western cities. In 1916, he returned to La Crosse as switchboard installer and maintenance man. In 1917 he entered the army, was assigned to the Signal Corps, and was detailed to install switchboards in several of the army camps during the war. He has been an active worker in the American Legion, serving as Post Commander at La Crosse and as vice commander of the Wisconsin state department. "Bill," as he is known by his friends, knows what service is, and the field covered by him should benefit by having him in its midst.



W. C. Strehl, Telephone Equipment Specialist.

Chicago, Ill.—Eastern end of the new Chicago-Seattle $1,000,000 circuit is practically completed. Western work is being rushed, Bell officials say.

Calumet, Mich.—Lowest down telephone users in the world are those employing the recently installed equipment in the Calumet-Hecla Consolidated mile-and-a-quarter deep mine near here.

Lepanto, Ark.—E. Ritter of Marked Tree has bought the local telephone company from Dan and Manley Portis.

Crosbyton, N. Mex.—Local interests have bought the Lovington Telephone Co., and plan extension of service in the neighboring oil fields.

PHILADELPHIA

CHESTNUT *and* 39*th* STREET ~

Hotel Pennsylvania

Fireproof—Unrestricted Parking

500 Rooms
400 Baths

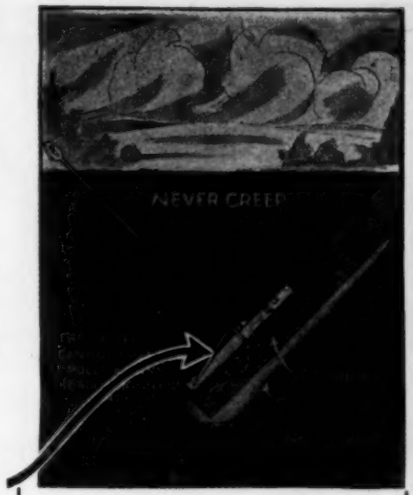
Only half minute from center of activities in very good residential location

Rooms with running water
from $2.50 per day

Rooms with private bath and shower
from $3.00 per day

Food and Service the Best

Near West Philadelphia Station Pennsylvania Railroad



In *Any* Soil

Never-Creep Anchors

have Superior Holding Power

In sandy, moist, adobe, or any other soils, the great holding surface of the NEVER-CREEP and its pull against solid, undisturbed earth gives an anchorage that is unsurpassed.

The more you look into anchor construction and performance the more you realize that undisturbed earth to pull against is a vital consideration. Tamping very seldom suffices to give the holding condition an anchor needs. Moisture seeps down to the holding plate of the anchor and collects there with a great sacrifice of the anchor's rigidity. You know how these factors ruin holding power, so play safe by standardizing the NEVER-CREEP and get away from the perils that are bound to come when the earth is disturbed during anchor installation.

The NEVER-CREEP alone has the Thimbleye rod.

Foremost wire companies prefer the NEVER-CREEP. So will you when you learn its complete story. Write us for details.

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Hotel
Knickerbocker
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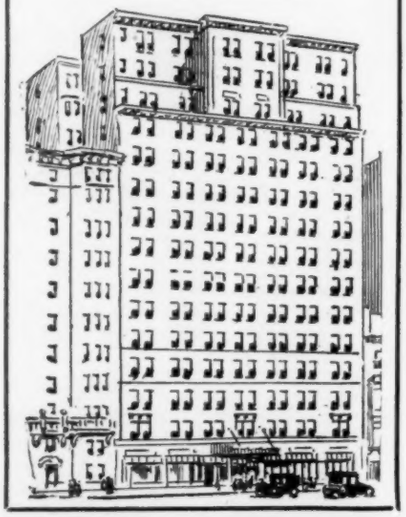
Just East of Broadway, Times Square

New York's Newest Hotel

A location unsurpassed. A few seconds to all leading shops and theatres. Away from the noise and bustle and still convenient to everything. Between Grand Central and Pennsylvania Terminals.

RATES
$3 to $5 per Day
400 Rooms—400 Baths



Everstick

Approved by Large Operating Companies For the Following Strains

6" 2-way	.....	2,200 lbs.
6" 4-way	.....	6,000 lbs.
8" 2-way	.....	6,000 lbs.
8" 4-way	.....	10,000 lbs.
10" 4-way	.....	16,000 lbs.

Write for Details

Everstick Anchor Co.
ST. LOUIS, MO.

Speedy!

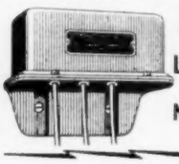
Just loop the wire on and drive. That's the way to install

EUREKA FIBRE INSULATED NAILS

Superior for telephone, telegraph and bell wiring. Uniform, finished appearance. Do not injure woodwork. Furnished in gray or black fibre: polished brass, oxidized or special wire nails; a flexible rubber bushing giving a thick insulation.

Prices and samples on application to

EUREKA SUPPLY CO.
Moorestown, N. J.



CHAPMAN
LIGHTNING ARRESTERS
MADE BY
MINNESOTA ELECTRIC CO.
MINNEAPOLIS, MINN.

Detroit Host to Vocational Championship Tournament

Detroit, Mich.—Telephone construction, installation and maintenance men from all parts of the state engaged in the third annual telephone vocational contests held here May 22. Events included installation of telephone instrument, switchboard multiple jack soldering work, assembling telephone instrument, cable metal work, cable splicing, private branch exchange switchboard cord changing, jumper wire soldering, line work, including placing aerial strand and cable on poles, private branch exchange switchboard cable forming.

Pease Issues Notable Drafting Catalog

Chicago, Ill.—A new catalog issued by the C. F. Pease Co. is said to be the most practical book of its kind. It gives detailed descriptions of the Pease line of blue printing machinery and accessories, drafting room furniture, drawing materials, photographic lamps and engineering supplies. The book is arranged for handy reference and will be a frequently used item in a purchasing department library. A copy of the new catalog will be sent free on request by the C. F. Pease Co., 813 North Franklin street, Chicago.

UNIQUE BLOW TORCH

It starts quickly, operates in any position, and produces a remarkable heat. It is a great worker in cold and windy weather.

The automatic orifice cleaner, one of the details shown in the illustration, is but one of a number of exclusive features that make the Unique your greatest value in blow torches.

Painstaking care by interested workmen, an actual "burning test" before shipping, is just another detail responsible for their uniformity and efficient burning qualities.

Write for complete details

Unique Manufacturing Co.
113 N. Desplaines St. CHICAGO, ILL.

RECONSTRUCTED EQUIPMENT

American Elec. 6-bar Extra heavy duty Bdg. hand Generators complete @	$ 2.75
Western Electric Co., No. 2-C Ball type Combine line drops and jacks, per strip of 5 @	7.75
Kellogg No. 3 100 ohm series combine line drops and jacks, per strip of 5 @	6.50
Dean or Garford Combine line drops and jacks, mounted 10 per strip 500 or 1000 ohm, per strip @	11.00
Burns No. 45 Express type Combine line drops and jack @	1.35
Western Elec. Co., 2500 ohm Biased ringers with gongs @	1.60
Am. Elec. Co., No. 360 type 3-bar 2500 ohm 4-party compacts with biased ringers @	6.75
American Elec. No. 36 type 5-bar 1600 ohm Bdg. compacts @	7.50
Chicago Telephone Supply Co., 4-bar 1000 or 1600 ohm Bdg. compacts @	6.75
Stromberg No. 500 4-bar 1000 or 1600 ohm Bdg. compacts @	6.90
Stromberg late type 1000 ohm self contained ringers complete less Gongs @	1.20
Mansbridge ½ M. F. Condensers @	.30
Dean No. 240 type 4-bar 1000 or 1600 ohm Bdg. compacts @	6.90
Garford Pony type 4-bar 1600 ohm Bdg. compacts @	8.50
Monarch 4-bar 1000 or 1600 ohm Bdg. compacts @	7.25
Kellogg No. 39 Unbreakable type C. B. desk sets complete with No. 75 Straight line steel signal sets @	6.75
Auto. Elec. Co., 600 ohm Extension bells @	1.25

REBUILT ELECTRIC EQUIPMENT CO.
Not Inc.
E. C. Stoeffhaas, Mgr.
1940 W. 21st Street CHICAGO, ILL.

We are not connected with or successors to Rebuilt Telephone Equipment Co.

Flexibility

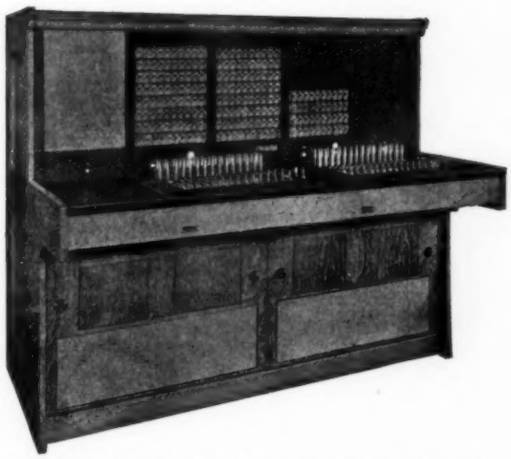
Is this switchboard flexible enough to meet the demands of our city for the next twenty years? Before buying, that is the question you must ask yourself. You buy magneto equipment today and five or ten years from now you wish you had purchased common battery for your present board is outgrown and you are forced to buy a larger one.

This combination magneto and common battery switchboard is flexible enough to meet every ordinary future requirement.

Compare these two boards. One—the latest type of magneto board with lamp supervision. The other, the same board converted to common battery, having every desirable feature for the size exchange it is intended to serve.

When built as a magneto board, space and arrangements are made for the additional equipment required in changing to common battery service. In making this change no rebuilding of the board is necessary—Two additional relays are added to the lamp supervisory cord circuits making them universal and the drops and jacks are replaced with lamps and jacks for the local lines.

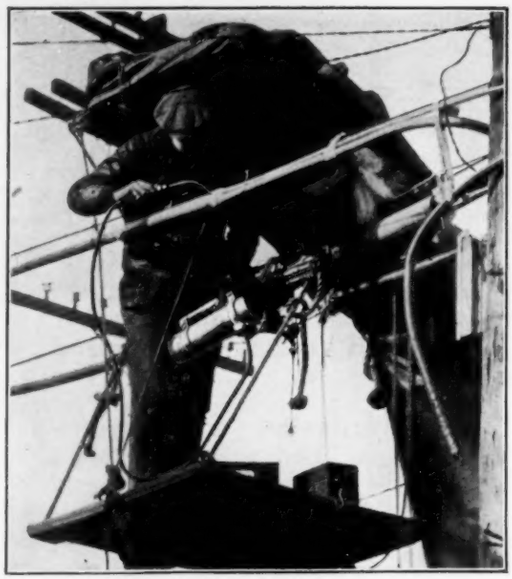
Let our salesman tell you how easy and inexpensive it is to change from magneto to common battery service at any time during the lifetime of the board.



COMBINATION board equipped for Magneto Service
Capacity—320 Magneto Lines

COMBINATION board equipped for Common Battery service
Capacity—400 Common Battery Lines and 80 Magneto Lines

Monarch Telephone Mfg. Co.
1027 WEST VAN BUREN ST., CHICAGO, ILL.



Linemen like it because it's always ready

WHEN a lineman wants *heat*, he wants it quickly and he wants the kind of heat that enables him to do fast, clean-cut work.

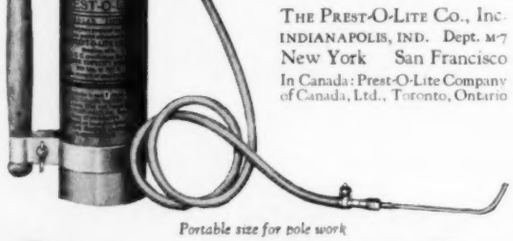
That's why linemen are enthusiastic about the new portable Prest-O-Lite Heating Equipment. It gives them what they want, when they want it.

No pumping, no generating. Just turn on the gas and get to work.

The Prest-O-Lite Soldering Iron is a great improvement too. Hot instantly and it *stays hot*.

The equipment operates on Prest-O-Lite Gas. This means economy and convenience as well, because empty tanks can be exchanged for full ones at any one of the thousands of Prest-O-Lite Service Stations located all over the country. You pay a small amount for the gas only.

We will furnish further details and demonstrate the efficiency of this equipment on request.



THE PREST-O-LITE CO., INC.
INDIANAPOLIS, IND. Dept. M-7
New York San Francisco
In Canada: Prest-O-Lite Company of Canada, Ltd., Toronto, Ontario

Portable size for pole work

Prest-O-Lite Gas

"The gas of a thousand uses"

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